Chapter 7.26 Data Mining Medical Information: Should Artificial Neural Networks be Used to Analyse Trauma Audit Data?

Thomas Chesney Nottingham University Business School, UK

> **Kay Penny** Napier University, UK

Peter Oakley University Hospital of North Staffordshire, UK

Simon Davies University of Birmingham Research Park, UK **David Chesney** Freeman Hospital, UK

Nicola Maffulli *Keele University School of Medicine, UK*

John Templeton Keele University School of Medicine, UK

ABSTRACT

Trauma audit is intended to develop effective care for injured patients through process and outcome analysis, and dissemination of results. The system records injury details such as the patient's sex and age, the mechanism of the injury, various measures of the severity of the injury, initial management and subsequent management interventions, and the outcome of the treatment including whether the patient lived or died. Ten years' worth of trauma audit data from one hospital are modelled as an Artificial Neural Network (ANN) in order to compare the results with a more traditional logistic regression analysis. The output was set to be the probability that a patient will die. The ANN models and the logistic regression model achieve roughly the same predictive accuracy, although the ANNs are more difficult to interpret than the logistic regression model, and neither logistic regression nor the ANNs are particularly good at predicting death. For these reasons, ANNs are not seen as an appropriate tool to analyse trauma audit data. Results do suggest, however, the usefulness of using both traditional and non-traditional analysis techniques together and of including as many factors in the analysis as possible.

INTRODUCTION

An Artificial Neural Network (ANN) attempts to model human intelligence using the neurons in a human brain as an analogy. ANNs have been described numerous times (Lee & Park, 2001; Bose & Mahapatra, 2001; Setiono, Thong, & Yap, 1998; Lee, Hung Cheng, & Balakrishnan, 1998), but a brief description is that the network accepts a series of factors as input, which it processes to output a probability that the input belongs to a certain class. For example, in the case of the trauma data analysed in this study, the characteristics of the trauma are the input to the ANN, which then outputs the probability that the patient will die. The processing is done by layers of neurons (called hidden layers) which apply a weight to each input factor according to how important that factor is in calculating the classification probability. The weight is learned by the network during its training. In training, a series of input factors to which the correct classification is known is fed into the ANN. The ANN then adjusts its weights to minimise the error between its predicted classification and the known correct class. A pictorial representation of an ANN is shown in Figure 1.

An ANN has the potential to discriminate accurately between patients who will live and those who will die, and can capture complex relationships between factors that traditional analysis methods may miss. However, there are two potential problems with using ANNs to analyse trauma data. First, they are affected by imbalances in the data (Fu, Wang, Chua, & Chu, 2002). A common characteristic of medical data is its imbalance (Cios & Moore, 2002). What this means is that the attribute of interest to data miners is likely to be present only in a minority of records in the dataset. In the case of the trauma data discussed here, a much higher percentage of patients lived than died. The second disadvantage with neural networks is that it is very difficult to explain and to justify the model. In other words, after train-



Output of h_p , $h_{lout} = g(w_p x_1 + w_y x_2 + b_p)$ Output of h_p , $h_{2out} = g(w_p x_1 + w_y x_2 + b_p)$ Output of node y, the output layer which uses the sigmoid function and is the probability of a certain class, for instance DEATH = I, given the input vector \overline{x} , $p(DEATH = I | \overline{x}) = s(v_1(h_{1out}) + v_2(h_{2out}) + b_0)$

12 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-

global.com/chapter/data-mining-medical-information/26368

Related Content

The Evolution of Hermite Transform in Biomedical Applications

Raghavan Gopalakrishnanand Dale H. Mugler (2010). *Intelligent Medical Technologies and Biomedical Engineering: Tools and Applications (pp. 260-278).* www.irma-international.org/chapter/evolution-hermite-transform-biomedical-applications/43259

EEG Synchronization and Brain Networks: A Case Study in Fatigue

Anwesha Sengupta, Subhadeep Datta, Sibsambhu Karand Aurobinda Routray (2015). *International Journal of Biomedical and Clinical Engineering (pp. 1-11).* www.irma-international.org/article/eeg-synchronization-and-brain-networks/138223

Fostering Meaningful Interaction in Health Education Online Courses: Matching Pedagogy to Course Types

Richard G. Fullerand Gary Kuhne (2009). *Medical Informatics: Concepts, Methodologies, Tools, and Applications (pp. 1417-1429).*

www.irma-international.org/chapter/fostering-meaningful-interaction-health-education/26307

The Development of a Quantitative Method for the Detection of Periarticular Osteoporosis Using Density Features within ROIs from Computed Radiography Images of the Hand

Seiichi Murakami, Hyoungseop Kim, Joo Kooi Tan, Seiji Ishikawaand Takatoshi Aoki (2013). *Technological Advancements in Biomedicine for Healthcare Applications (pp. 55-67).* www.irma-international.org/chapter/development-quantitative-method-detection-periarticular/70848

Relationship Between Speed of Performing Leg Extension With 30 RM Load and the Selected EMG Variables of Selected Quadricep Muscles

Dhananjoy Shaw, Deepak Singh, Umesh Kumar Ahlawat, Manvinder Kaurand Dinesh Bhatia (2021). International Journal of Biomedical and Clinical Engineering (pp. 61-76). www.irma-international.org/article/relationship-between-speed-of-performing-leg-extension-with-30-rm-load-and-theselected-emg-variables-of-selected-quadricep-muscles/272063