USING GENERALIZED ADDITIVE MODELS AND NEURAL NETWORKS TO PREDICT MORTALITY IN INTENSIVE CARE UNITS

Ana Papoila[1], Cristina Rocha[2] and Patrícia Xufre[3]

[1]Department of Biostatistics and Informatics, Faculty of Medical Sciences, New University of Lisbon, CEAUL, Portugal
[2]Department of Statistics and Operational Research, Faculty of Sciences, University of Lisbon, CEAUL, Portugal
[3]Faculty of Economics, New University of Lisbon, CIO, Portugal

During the last two decades, evaluating severity of illness and predicting mortality of critical patients became a major concern of all professionals that work in intensive care units all over the world. Scores were developed using variables with known influence on death and probabilities of non-survival were calculated. Due to the binary nature of the response variable, logistic regression models were a natural choice for modelling this kind of data. Nevertheless, this is not an easy task and a poor predictive performance of some of the existing mathematical models has been reported by clinicians of several countries. Believing that Generalized Additive Models (GAMs) will bring significative improvements, we suggest the use of these models to predict mortality in a Portuguese intensive care unit (ICU). A data set of 996 patients was collected and the entire sample was used for the development of the model and also for the cross-validation process, due to the nonexistence of an external, independent data set. The performance of the proposed methodology was assessed not only by the evaluation of the agreement between observed mortality and predicted probabilities of death through the use of the Hosmer-Lemeshow goodness-of-fit test and of calibration curves but also by the discriminating ability measured by the area under the ROC (Receiver Operating Characteristic) curve. A comparison of the final model results with the ones obtained via the standard severity of illness score SAPS II (new Simplified Acute Physiology Score), used in the referred unit, was made. Another way to solve this problem is by using Artificial Neural Networks (ANNs). In fact, feed-forward neural networks have been increasingly applied in the medical field, namely in situations where a logistic regression analysis is the standard approach. In this type of problems, ANN can be used as a non-parametric regression method particularly apt to deal with non-linearities in the data. An evaluation of the results obtained via ANNs was also carried out.