Chapter 46
Machine Learning Applications for Classification Emergency and Non-Emergency Patients

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ABSTRACT

Emergency departments of hospitals are busy. In recent years, patient arrivals have significantly risen at emergency departments in Turkey like other countries in the world. The main important features of emergency services are uninterrupted service, providing services in a short time, and priority to emergency patients. However, patients who do not need immediate treatment can sometimes apply to this department due to several reasons like working time and short waiting time. This situation can reduce efficiency and effectiveness at emergency departments. On the other hand, computers solve complex classification problems by using machine learning methods. The methods have a wide range of applications, such as computational biology and computer vision. Therefore, classification of emergency and non-emergency patients is vital to increase productivity of the department. This chapter tries to find the best classifier for detection of emergency patients by utilizing a data set.

INTRODUCTION

The healthcare management system encounters some difficulties since demand has increased significantly in recent years. The primary purpose of the efficient healthcare management system is to improve quality, to reduce total cost, and increase the satisfaction of patients. One of the main problems in the hospital is to manage emergency departments (ED) because it has a highly dynamic structure. The ED

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encounters high patients demand during peak hours because the ED is more complex and uncertain than other units of hospitals. Therefore, prolonged waiting times in the department lead to dissatisfaction with patients (Gul & Guneri, 2012.; Xu, Wong, & Chin, 2013). One of the primary purposes in the ED is to minimize the waiting time of patients. Therefore, the patients must be classified according to non-emergency and emergency patients to reduce the waiting time because non-emergency patients cause to increase in the total number of patients significantly and waiting times of emergency patients. In this way, non-emergency patients can be forward to another unit of the hospital using this classification.

Concerning healthcare management literature, Wrenn, Jones, Lanaghan, Congdon, & Aronsky (2005) provide an artificial neural network to forecast the length of ED stay of patients. The data feature contains several variables form age to laboratory exams. Gul & Guneri (2012) work a computer simulation of an ED in a hospital to develop a resource utilization rate to decrease patient waiting time. Li, Tian, Liu, Shu, & Liang (2013) present a type of neural network to build a prediction model to estimate the length of hospital stay. In their case, data contains 921 patients, and the model gives 80% accuracy. On the other hand, Xu et al. (2013) are also interested in the classification of emergency and non-emergency patients. They use an artificial neural network to model the problem, and it is compared with the non-linear least square regression (NLLSR) and multiple linear regression (MLR) in terms of mean average percentage error. Gul and Guneri (2015a) provide a model to estimate the length of ED stays in hospitals with the use of an artificial neural network technique. The model is built based on ED medical personnel. The data includes 1500 ED patients with 21 features, such as categorical and numerical variables. A recent review paper by Gül & Güneri (2015b) can be analyzed for detail information about healthcare management about applications for regular and disaster conditions.

Machine learning methods are efficient tools which can improve diagnostic accuracy in several diseases (Bala & Goyal, 1998; Baştürk, Badem, Caliskan, & Yüksel, 2019; Caliskan & Yuksel, 2017; Safavian & Landgrebe, 1990; Tomioka, Aihara, & Müller, 2007). Compared to sophisticated diagnoses techniques which required highly educated experts, machine learning methods are a very affordable and useful tool to support experts (Bishop, 2006; Çetin, Temurtaş, & Gülgönül, 2015, Caliskan 2017). Therefore, machine learning methods can be used in any country where people cannot reach suitable medical services. On the other hand, these techniques can be used all over the world to help experts whose number is minimal.

In light of the literature mentioned above, the purpose of this study is to classify emergency and non-emergency patients using machine learning methods, including decision tree (DT), support vector machines (SVM), K-nearest neighbour algorithm (KNN) and logistic regression (LR). The data is obtained from Gül & Güneri (2015a). Although original data contains 1500 samples, there is a significant imbalance between the emergency and non-emergency classes. The equal number of data is selected for each class to eliminate imbalance data. In the end, the data set has 22 features with 368 samples and two classes.

The rest of the paper is organized as follows. In Section 2, the machine learning methods and performance metrics are proposed. In Section 3, the computational study is presented to compare the performance of the proposed methods. Conclusions, directions for future research and managerial impacts are argued in the last section.