

## Chapter 56

# Health Insurance Claim Prediction Using Artificial Neural Networks

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### ABSTRACT

*A number of numerical practices exist that actuaries use to predict annual medical claim expense in an insurance company. This amount needs to be included in the yearly financial budgets. Inappropriate estimating generally has negative effects on the overall performance of the business. This study presents the development of artificial neural network model that is appropriate for predicting the anticipated annual medical claims. Once the implementation of the neural network models was finished, the focus was to decrease the mean absolute percentage error by adjusting the parameters, such as epoch, learning rate, and neurons in different layers. Both feed forward and recurrent neural networks were implemented to forecast the yearly claims amount. In conclusion, the artificial neural network model that was implemented proved to be an effective tool for forecasting the anticipated annual medical claims for BSP Life. Recurrent neural network outperformed the feed forward neural network in terms of accuracy and computation power required to carry out the forecasting.*

DOI: 10.4018/978-1-6684-2408-7.ch056

## **1. INTRODUCTION**

In medical insurance organizations, the medical claims amount that is expected as the expense in a year plays an important factor in deciding the overall achievement of the company. BSP Life (Fiji) Ltd. provides both Health and Life Insurance in Fiji. Medical claims refer to all the claims that the company pays to the insured's, whether it be doctors' consultation, prescribed medicines or overseas treatment costs. Claims received in a year are usually large which needs to be accurately considered when preparing annual financial budgets. These claim amounts are usually high in millions of dollars every year. An increase in medical claims will directly increase the total expenditure of the company thus affects the profit margin. Currently utilizing existing or traditional methods of forecasting with variance. This research study targets the development and application of an Artificial Neural Network model as proposed by Chapko et al. (2011) and El-said et al. (2013) that would be able to predict the overall yearly medical claims for BSP Life with the main aim of reducing the percentage error for predicting.

According to Rizal et al. (2016), neural network is very similar to biological neural networks. Neural networks can be distinguished into distinct types based on the architecture. Two main types of neural networks are namely feed forward neural network and recurrent neural network (RNN). Artificial neural networks (ANN) have proven to be very useful in helping many organizations with business decision making. Example, Sangwan et al. (2020) proposed artificial neural network is commonly utilized by organizations for forecasting bankruptcy, customer churning, stock price forecasting and in many other applications and areas. This research focusses on the implementation of multi-layer feed forward neural network with back propagation algorithm based on gradient descent method. The network was trained using immediate past 12 years of medical yearly claims data. Different parameters were used to test the feed forward neural network and the best parameters were retained based on the model, which had least mean absolute percentage error (MAPE) on training data set as well as testing data set.

In the insurance business, two things are considered when analysing losses: frequency of loss and severity of loss. Previous research investigated the use of artificial neural networks (NNs) to develop models as aids to the insurance underwriter when determining acceptability and price on insurance policies. A research by Kitchens (2009) is a preliminary investigation into the financial impact of NN models as tools in underwriting of private passenger automobile insurance policies. Results indicate that an artificial NN underwriting model outperformed a linear model and a logistic model. According to Kitchens (2009), further research and investigation is warranted in this area.

In the past, research by Mahmoud et al. (2013) and Majhi (2018) on recurrent neural networks (RNNs) have also demonstrated that it is an improved forecasting model for time series. To demonstrate this, NARX model (nonlinear autoregressive network having exogenous inputs), is a recurrent dynamic network was tested and compared against feed forward artificial neural network. Abhigna et al. (2017) state that artificial neural network (ANN) has been constructed on the human brain structure with very useful and effective pattern classification capabilities. ANN has the ability to resemble the basic processes of human's behaviour which can also solve nonlinear matters, with this feature Artificial Neural Network is widely used with complicated system for computations and classifications, and has cultivated on non-linearity mapped effect if compared with traditional calculating methods. According to Zhang et al. (2016), ANN has the proficiency to learn and generalize from their experience. The authors Motlagh et al. (2016) emphasize that the idea behind forecasting is previous know and observed information together with model outputs will be very useful in predicting future values. In neural network forecasting,

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