

# Chapter XIV

## Adaptive Higher Order Neural Network Models and Their Applications in Business

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### **ABSTRACT**

*Business is a diversified field with general areas of specialisation such as accounting, taxation, stock market, and other financial analysis. Artificial Neural Networks (ANN) have been widely used in applications such as bankruptcy prediction, predicting costs, forecasting revenue, forecasting share prices and exchange rates, processing documents and many more. This chapter introduces an Adaptive Higher Order Neural Network (HONN) model and applies the adaptive model in business applications such as simulating and forecasting share prices. This adaptive HONN model offers significant advantages over traditional Standard ANN models such as much reduced network size, faster training, as well as much improved simulation and forecasting errors, due to their ability to better approximate complex, non-smooth, often discontinuous training data sets. The generalisation ability of this HONN model is explored and discussed.*

### **INTRODUCTION**

Business is a diversified field with several general areas of specialisation such as accounting or financial analysis. Artificial Neural networks (ANNs) provide significant benefits in business applications. They have been actively used for applications such as bankruptcy prediction,

predicting costs, forecast revenue, processing documents and more (Kurbel et al, 1998; Atiya et al, 2001; Baesens et al, 2003). Almost any neural network model would fit into at least one business area or financial analysis. Traditional statistical methods have been used for business applications with many limitations (Azema-Barac et al, 1997; Blum et al, 1991; Park et al, 1993).

Human financial experts usually use charts of financial data and even intuition to navigate through the massive amounts of financial information available in the financial markets. Some of them study those companies that appear to be good for long-term investments. Others try to predict the future economy such as share prices based on their experiences, but with the large number of factors involved, this seems to be an overwhelming task. Consider this scenario: how can a human financial expert handle years of data for 30 factors, 500 shares, and other factors such as keeping track of the current values simultaneously? This is why some researches insist that massive systems such as the economy of a country or the weather are not predictable due to the effects of chaos. But ANNs can be used to help automate such tasks (Zhang et al, 2002).

ANNs can be used to process subjective information as well as statistical data and are not limited to particular financial principle. They can learn from experience (existing financial data set) but they do not have to follow specific equations or rules. They can be asked to consider hundreds of different factors, which is a lot more than what human experts can digest. They won't be overwhelmed by decades of financial data, as long as the required computational power has been met. ANNs can be used together with traditional statistical methods and they do not conflict with each other (Dayhoff, 1990).

Using ANNs for financial advice means that you don't have to analyse complex financial charts in order to find a trend (of, eg, a share). The ANN architecture determines which factors correlate to each other (each factor corresponds with an input to the ANN). If patterns exist in a financial dataset, an ANN can filter out the noise and pick up the overall trends. You as the ANN program user decide what you want the ANN to learn and what kind of information it needs to be given, in order to fulfill a financial task.

ANN programs are a new computing tool which simulate the structure and operation of

the human brain. They simulate many of the human brain's most powerful abilities such as sound and image recognition, association, and more importantly the ability to generalize by observing examples (eg, forecasting based on existing situation). ANNs establish their own model of a problem based on a training process (with a training algorithm, so no programming is required because existing training programs are readily available).

Some large financial institutions have used ANNs to improve performance in such areas as bond rating, credit scoring, target marketing and evaluating loan applications. These ANN systems are typically only a few percentage points more accurate than their predecessors, but because of the amounts of money involved, these ANNs are very profitable. ANNs are now used to analyze credit card transactions to detect likely instances of fraud (Kay et al, 2006).

While conventional ANN models have been bringing huge profits to many financial institutions, they suffer from several drawbacks. First, conventional ANNs can not handle discontinuities in the input training data set (Zhang et al, 2002). Next, they do not perform well on complicated business data with high frequency components and high order nonlinearity, and finally, they are considered as 'black boxes' which can not explain their behaviour (Blum et al, 1991; Zhang et al, 2002 ; Burns, 1986).

To overcome these limitations some researchers have proposed the use of Higher Order Neural Networks (HONNs) (Redding et al, 1993 ; Zhang et al, 1999 ; Zhang et al, 2000). HONNs are able to provide some explanation for the simulation they produce and thus can be considered as 'open box' rather than 'black box'. HONNs can simulate high frequency and high order nonlinear business data, and can handle discontinuities in the input training data set (Zhang et al, 2002). Section 3 of this chapter offers more information about HONNs.

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