Preface

Business data is arguably the most important asset that an organization owns. Whether the data records sales figures for the last 5 years, the loyalty of customers, or information about the impact of previous business strategies, the potential for improving the business intelligence of the organization is clear. Most businesses are now storing huge volumes of data in data warehouses, realizing the value of this information. The process of converting the data into business intelligence, however, still remains somewhat a mystery to the broader business community.

Data mining techniques such as neural networks are able to model the relationships that exist in data collections and can therefore be used for increasing business intelligence across a variety of business applications. Unfortunately, the mathematical nature of neural networks has limited their adoption by the business community, although they have been successfully used for many engineering applications for decades.

This book aims to demystify neural network technology by taking a how-to approach through a series of case studies from different functional areas of business. Chapter 1 provides an introduction to the field of neural networks and describes how they can be used for prediction, classification, and segmentation problems across a wide variety of business areas. The two main types of neural networks are presented in this introductory chapter. The first is the multilayered feedforward neural network (MFNN) used for prediction problems, such as stock market prediction, and classification problems, such as classifying bank loan applicants as good or bad credit risks. The second type of neural network is the self-organizing map (SOM) used for clustering data according to similarities, finding application in market segmentation, for example. These two main neural network architectures have been used successfully for a wide range of business areas as described in chapter 1, including retail sales, marketing, risk assessment, accounting, financial trading, business management, and manufacturing.

The remainder of the book presents a series of case study chapters and is divided into sections based on the most common functional business areas: sales and marketing, risk assessment, and finance. Within each of these sections, the chapters use MFNNs, SOMs, and sometimes both neural network models to provide increased business intelligence. The following table presents the business area covered within each chapter and shows the neural network model used.
Chapters 2 through 6 comprise the first section of the book dealing with the use of neural networks within the area of retail sales and marketing.

In Chapter 2, Zhang and Qi illustrate how best to model and forecast retail sales time series that contain both trend and seasonal variations. The effectiveness of data preprocessing methods, such as detrending and deseasonalization on neural network forecasting performance, is demonstrated through a case study of two different retail sales: computer store sales and grocery store sales. A combined approach of detrending and deseasonalization is shown to be the most effective data preprocessing that can yield the best forecasting result.

Chapter 3 presents a case study from the insurance industry by Yeo et al. that examines the effect of premium pricing on customer retention. Clustering is first used to classify policy holders into homogeneous risk groups. Within each cluster a neural network is then used to predict retention rates given demographic and policy information, including the premium change from one year to the next. It is shown that the prediction results are significantly improved by further dividing each cluster according to premium change and developing separate neural network models for homogeneous groups of policy holders.

In chapter 4, Ip et al. describe the use of neural networks to manage customer relationships, with a focus on early identification of loyal and highly profitable customers. The term *high-value customer* is used to describe those customers whose transactional data indicates both loyalty and profitable transactions. A neural network is developed to predict the long-term value of customers after observing only three months of transaction data. The transactional data warehouse of a large Japanese drugstore chain is used as a case study.
Market segmentation of hotel clients is the focus of chapter 5 by Cardoso and Pires. A questionnaire completed by hotel clients requesting demographic and psychographic information is coupled with transactional data. A self-organizing map is used to generate the clusters or segments, and the results are compared to the clusters generated using an alternative statistical clustering method. Once the segments are obtained, they are statistically profiled to provide new insights about the clients and to help the hotel management better support new marketing decisions.

The final chapter in the section on retail sales and marketing is the contribution of Potharst et al. which applies neural networks to a target marketing problem. A large Dutch charity organisation provides the case study for the chapter. A neural network is developed to predict people’s propensity to donate money to the charity based on their demographic information as well as previous donations.

The next section presents a series of chapters relating to risk assessment, addressing both corporate and consumer risk. Corporate survival prediction and credit rating analysis are presented in chapters 7 to 9, while consumer risk assessment in the banking and insurance domains are the focus of chapters 10 and 11.

In chapter 7, Bose and Argarwal are concerned with predicting the financial health of so-called click-and-mortar corporations, those with only a web presence in the marketplace. Using publicly available data on a collection of such companies, financial variables and accounting ratios are used to develop a neural network model predicting which companies will survive or undergo bankruptcy in the next 2-3 years.

St. John et al. are also concerned with predicting the future financial health of companies in chapter 8, but are more concerned with the question: can a firm’s financial performance be predicted with accuracy from the corporate strategy decisions of the executive management team? Their approach to answering this question is to use the patterns of corporate strategy decisions employed by several large corporations over a period of 5 years to predict performance differences. By training a neural network on the strategies and health of a sub-sample of firms, and then applying the network to a new sample of firms, the trained neural network can be used to predict which firms will create wealth and those that will destroy wealth in the future.

In chapter 9, Tan et al. examine the credit ratings of companies issued by Standard & Poor’s Corporation and develop a credit rating classification model based on key financial ratios. A self-organizing map is used to cluster the companies according to their financial characteristics as expressed in financial statements, thus creating a financial landscape of the data. The resulting clusters are then examined to infer the relationships that exist between financial characteristics and credit rating.
In chapter 10 we turn to consumer risk assessment as West demonstrates that both MFNNs and SOMs can be used to model the relationships between loan applicants’ banking histories, demographic data, and their likelihood of defaulting on their loans. The work is particularly focused on identifying borderline applicants, a market segment referred to as “subprime lending,” due to the high profits that can be made when bank customers struggle to make repayments but do not default. The final product is a neural network decision support system that facilitates subprime lending and identifies poor credit risks.

The final chapter in the risk assessment section is the contribution of Kitchens et al. in chapter 11, who focus on predicting the likely incidence of an automobile insurance claim. A neural network is used to develop a decision support tool to assist the underwriting process. Variables include driver and vehicle descriptions, as well as driving records and subsequent losses on those policies. A case study from a large international insurance company is used, consisting of over 100,000 records from private passenger automobile policies in the United States.

The last section of this book focuses on applications of neural networks in the financial markets. For many more case studies describing successful neural network models in this domain, the interested reader is referred to Refenes, A. P. (Ed.), Neural Networks in the Capital Markets, Chichester: John Wiley & Sons, 1995.

Chapter 12 by Yao and Tan reports empirical evidence that neural network models are applicable to the prediction of foreign exchange rates. Time series data and technical indicators are fed into a neural network model designed to capture the underlying relationships in the movement of currency exchange rates. The exchange rates between the U.S. dollar and five other major currencies are predicted: Japanese yen, Deutsch mark, British pound, Swiss franc, and Australian dollar.

The next chapter in this section is chapter 13 by Malliaris and Salchenberger, who study the inter-relationships amongst the international equity markets. Specifically, both MFNN and SOM neural approaches are used to look for any influence of eastern markets (Japan, Hong Kong, and Australian) on the S&P 500 index. The neural network results are compared to a standard benchmark, the random walk forecast.

Chapter 14, by Lajbcygier, focuses on the use of neural networks for forecasting the option prices of the futures market. The accuracy of the MFNN model is compared to the more traditional approaches of the Black Scholes model, the modified Black model, and the Barone-Adesi/Whaley model. A useful review of option pricing is also provided.
The final chapter of the book, chapter 15, by Smith and Lokmic, describes the use of both MFNN and SOM architectures for forecasting cash flow in the daily operations of a financial services company. The problem is to forecast the date when issued cheques will be presented by customers, so that the daily cash flow requirements can be forecast and appropriate levels of funds are maintained in the company’s bank account to avoid overdraft charges or unnecessary use of investment funds. The SOM is used to group the cheques into different categories, and several MFNN models are developed within each group. The neural network results are compared to the accuracy of the forecasts obtained using the company’s existing method.

Thus, this book provides a collection of case studies from a wide range of business areas that have been written to facilitate implementation within any organization with similar requirements. In each case, the data collection process and preprocessing is fully described, the neural network methodology is reported with a minimum of mathematics, and the results are discussed. It is hoped that the book will enable the business community to start benefiting more widely from this powerful technology.

**Acknowledgments**

This book would not have been possible without the cooperation of many people: the authors, reviewers, our colleagues, and the staff at Idea Group Publishing (IGP). The editors would like to thank Mehdi Khosrowpour for inviting us to produce this book, Jan Travers for managing the project, and Michele Rossi as development editor for answering our questions and keeping us on schedule. The resources that the staff at IGP provided assisted us enormously.

The idea for this book came from a special issue of the international journal, *Computers and Operations Research* that we guest edited in 1999-2000. The special issue (volume 27, numbers 11-12, 2000) was devoted to neural networks in business, and we were overwhelmed with the number of submissions. Unfortunately we couldn’t publish all of them in the special issue, but it made us aware of how many interesting applications of neural networks there are from academicians and practitioners alike. Thus we are also grateful to Sam Raff, editor-in-chief of *Computers and Operations Research*, for giving us the opportunity to guest edit the journal.

Many of the authors of chapters in this book also served as reviewers of other chapters, and so we are doubly appreciative of their contribution. We also acknowledge our respective universities, Monash University (Australia) and Ball State University (USA), for affording us the time to work on this project, and our colleagues and students for many stimulating discussions.

Kate A. Smith, Ph.D.  Jatinder N. D. Gupta, Ph.D.
Monash University, Australia  Ball State University, USA