References

DeLurgio, S. (1998). *Forecasting principles and applications*. New York:: Irwin/McGraw-Hill.

Gardner Jr., E. (1990). Evaluating forecast performance in an inventory control system. *Management Science*, *36*, 490–499.

Hanke, J. E., & Reitsch, A. G. (1998). *Business forecasting* 6th edition). Englewood Cliffs, NJ:: Prentice-Hall.

Silver, E. A., Pyke, D. F., & Peterson, R. (1998). *Inventory management and production planning and scheduling* (3rd edition). New York:: John Wiley & Sons Inc.

Aris A. Syntetos
*The School of Management, University of Salford,
Maxwell Building, The Crescent,
Salford M5 4WT, UK*
E-mail address: a.syntetos@salford.ac.uk.
Tel.: +44 161 295 5804;
fax: +44 161 295 5556.

Paul D. McNelis, *Neural networks in finance—gaining predictive edge in the market,* Elsevier Academic Press, 2005, ISBN 0-12-485967-4, hardcover, 243 pages

Probably finance is the area in business and economics where neural networks have been applied most frequently. A Google search on "neural networks" and "finance" delivers just under half a million hits. Several books and review articles on the topic already exist, e.g. Azoff (1994), Refenes (1995), Gately (1996), and Zhang, Patuwo and Hu (1998). Writing a new book on the topic is therefore quite a bold endeavour in itself, for which the author deserves praise.

The book is divided into two parts. Part I, comprising Chapters 2 to 4, covers the basic theory of neural networks. Part II, comprising Chapters 5 to 9, consists of empirical applications of neural networks in different areas of economics and finance.

Chapter 2 discusses the structure and interpretation of neural networks, focusing on the single hidden-layer feedforward neural network that is central to the book. A nice feature of this chapter is that relationships between neural networks and other econometric models and statistical tools are

pointed out, including smooth transition models, discrete choice models, dimensionality reduction and principal components.

Chapter 3 deals with the topic of estimating neural network parameters. There is surprisingly little attention paid to "traditional" estimation methods based on local gradient-based search algorithms such as backpropagation and Bayesian regularization. Instead, the chapter emphasizes the potential of "global" optimization methods such as simulated annealing and, in particular, genetic algorithms and evolutionary computing for estimating neural networks. The intuition behind the latter method, which perhaps is less well-known to (financial) economists is explained clearly, as well as the technical details involved.

Chapter 4 is on the evaluation of neural networks. This chapter not only contains an extensive overview of conventional in-sample diagnostics, but also stresses out-of-sample forecasting performance as the ultimate test of a neural network (or any other nonlinear model). For that purpose, the chapter includes an extensive overview of statistics for testing equal predictive accuracy of competing models.

Chapter 5 presents several simulation experiments with different linear and nonlinear data-generating processes. In this controlled environment, it is shown that neural networks have a competitive advantage over conventional linear models exactly when the true mechanism underlying the data is "substantially nonlinear".

The "real-world" empirical applications in Chapters 6 to 9 include examples of forecasting (of production in the automotive industry, corporate bond spreads and inflation), classification (of credit card defaults and bank failures), and dimensionality reduction (in option pricing) with neural networks. In each case, linear models and neural networks are estimated for the relevant data set and used for the purpose at hand. In many cases, the neural network is found to be superior.

The book certainly makes a useful addition to the existing voluminous literature on neural networks in finance for several reasons. First, the description of the genetic algorithm in Chapter 3 is concise yet clear and accessible for readers without any prior knowledge about the technique. Second, the book is supported by a website containing

Matlab code for neural networks, giving readers the opportunity to start working with these models straightaway. Third, the broad range of empirical applications clearly demonstrates that the usefulness of neural networks is not confined to a specific area, but stretches across many quite diverse topics in economics and finance.

At the same time, the book also has some limitations. First, as mentioned above, Chapter 3 on estimation focuses almost exclusively on the genetic algorithm. A more balanced overview of different estimation methods, including a discussion of relative (dis-)advantages would have been welcome. In particular, a comparison of the genetic algorithm with more conventional techniques such as Bayesian regularization and cross-validation in the controlled simulation environment of Chapter 5 would have been informative. Second, although the book discusses (mis-)specification testing and the evaluation of neural networks along with estimation, what is missing is an outline of a sensible "neural network model building procedure", in the spirit of Medeiros et al. (2006), for example. In particular, important questions concerning the design of the network (such as which input variables to use, and how to decide upon the appropriate number of hidden units) are nowhere addressed. This is a pity, given that these decisions appear to be crucial for the successful application of neural networks; once these choices are made, estimation, evaluation and forecasting are "technicalities".

To sum up, the book is a good starting point to gain a predictive edge in the financial markets, but it may be worthwhile to look a bit further in order to expand the edge.

References

Azoff, E. M. (1994). *Neural network time series forecasting of financial markets*. Chichester: John Wiley & Sons.

Gately, E. (1996). *Neural networks for financial forecasting*. New York: John Wiley & Sons.

Medeiros, M., Terasvirta, T., & Rech, G. (2006). Building neural network models for time series: A statistical approach. *Journal of Forecasting*, *25*(1), 49–75.

Refenes, A. N. (1995). *Neural networks in the capital markets*. Chichester: John Wiley & Sons.

Zhang, G., Patuwo, B. E., & Hu, M. Y. (1998). Forecasting with artificial neural networks: The state of the art. *International Journal of Forecasting*, *14*, 35–62.

Dick Van Dijk
Econometric Institute, Erasmus University Rotterdam
E-mail address: djvandijk@few.eur.nl.

3 October 2005

Arnold Zellner, *Statistics, Econometrics and Forecasting. The Stone Lectures in Economics,* Cambridge University Press, 2004, 163 pp, ISBN 0 521 54044 5 (paperback), \$24.99, ISBN 0 521 83287 X (hardback), \$70

The title of the book is well chosen: Professor Arnold Zellner is an excellent statistician, econometrician, forecaster, and economist. Few command such a wide field in an era when people tend to get more and more specialized. The book contains two lectures that Zellner gave in London in May 2001 when he was elected Stone Lecturer in Economics.[1] Stone and Zellner have in common that they both advocate "measurement with theory", not one without the other.

Zellner is the grand old man of econometrics and a fellow of the IIF. These two lectures could be regarded as his abbreviated scientific biography. It is written in a fluent style that, with little effort, provides a glimpse into his huge scientific contribution, where forecast performance is an important model criterion. The astonishingly broad scientific perspective maintains the interest all through the text.

Readers who attended ISF2000 in Lisbon may recall that Zellner was one of the keynote speakers, and will recognize the empirical part of the book, based on what he calls "SEMTSA" (Structural Econometric Modeling, Time Series Analysis). This starts with the simplest kind of model that fits the data and forecasts better than the naïve alternative. The model is then successively elaborated, trying to incorporate economic theory, but requiring an even better fit in-sample and further improved accuracy of forecasts. This could be viewed as the opposite strategy to "from general to specific". Here one meets

---

[1] Sir Richard Stone is best known for creating the National Accounts. In 1984 he was awarded the Prize in Economic Sciences in Memory of Alfred Nobel.