Chapter 14
Conclusions and Further Work

Abstract This chapter summarises this book and makes recommendations for further studies. It demonstrates that indeed artificial intelligence is a viable tool for analyzing economic data. It also demonstrates that the accuracy of the artificial intelligence method depends on the problem at hand and that there is a wide scope of applying other emerging artificial intelligence techniques to model economic data.

14.1 Conclusions

This book introduced economic modeling based on artificial intelligence techniques. The artificial intelligence methods used included multi-layer perceptrons, radial basis functions, support vector machines, rough sets techniques, automatic relevance determination, autoassociative network, particle swarm optimization, genetic algorithms, simulated annealing, Bayesian networks, and multi-agent systems (Marwala 2007, 2009, 2010, 2012; Marwala and Lagazio 2011). Some other approaches that were studied included game theory, control systems, Fourier transforms and wavelet transforms. The book introduced important themes such as economic data handling and modeling as well as prediction, knowledge discovery including data mining and causality versus correlation. It also outlined some of the common problems in economic modeling with regards to data handling, modeling and data interpretation. The book analyzed various economic data such as the stock market, inflation, credit rating, option pricing, portfolio optimization and described important subjects such as inflation targeting.

The book introduced robust methods for economic data analysis and these were the mean, variance, kurtosis, fractals, frequency, time-frequency analysis techniques and stationarity. The Bayesian and the evidence frameworks were applied to generate an automatic relevance determination (ARD) tool. The ARD tool was used to evaluate the relevance of economic variables that were important for driving the consumer price index (CPI).

The multi-layered perceptron, radial basis functions and support vector machines were applied to model the CPI. The results indicated that the SVM gave the best results followed by the MLP and then the RBF.

Support vector machines and the multi-layered perceptron methods were applied using the Bayesian method to model American options and the results indicated that the MLP gave better results than the SVM. This book also introduced rough set theory and applied this to stock price prediction and observed high accuracy on classifying the daily movements of the Johannesburg Stock Exchange's All Share Index. The book applied auto-associative networks based multi-layered perceptron with genetic algorithms, particle swarm and simulated annealing optimization techniques for modeling manufacturing data and demonstrated that simulated annealing performed marginally better, followed by genetic algorithms and then the particle swarm optimization technique.

Furthermore, this book treated a predictive system as a missing data problem *i.e.* correlation machine and compared it to treating it as a cause and effect exercise *i.e.* causal machine. The correlation machine applied the autoassociative network, while the causal machine used the ARD. These approaches were applied to model the CPI and credit scoring. The ARD technique was found to be able to asses the causal relationships between the variables and the causal machine was found to perform better than the correlation machine for modeling credit scoring data while the correlation machine was found to perform better than the causal machine for modelling the CPI.

Genetic algorithms (GA) were applied for the continual rebalancing of portfolios. When both risk and return were targeted, the results showed that a GA was a viable tool for optimizing a targeted portfolio. The book applied an incremental learning procedure to predict the financial markets movement direction. Incremental learning was found to provide good results on adapting the weak networks into a strong learning algorithm that has confidence in all its decisions. The procedure was found to increase confidences in correctly classified instances and decrease confidences in misclassified instances after successive training sessions.

This book also simulated the stock market and implemented these within the game theory framework and the results indicated that this approach was a viable method for simulating the stock market. A control system approach was built for inflation targeting. The input/output model was built using a multi-layered perceptron network and a closed loop control strategy was adopted using GA to control inflation through the manipulation of interest rate. The calculated interest rate was compared to the historical inflation rate to evaluate the effectiveness of the control strategy and good results were obtained. The book also studied the role of trade in promoting peace and healthy economic activities, and the results indicated that trade was important for maintaining peace.

14.2   Further Work

For further studies, articial intelligence should be used to predict prices of crucial minerals, such as platinum, and relate these to economic growth of resource based economies. Another area for further study is the application of artificial intellence in remanufacturing, an area that is very important for modern industrialization. This book applied missing data approaches to classification and regression in economic modeling. For further studies, other techniques should be applied for missing data approaches to regression and classification, and these should include the Expectation Maximization Approach, Random Forrest, Firefly Algorithm, and Artificial Immune Systems.

References

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