Chapter I

Financial Modeling and Forecasting with an Evolutionary Artificial Neural Network

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ABSTRACT

In this chapter, I consider a design framework of a computational experiment in finance. The examination of statistics used for economic forecasts evaluation and profitability of investment decisions, based on those forecasts, reveals only weak relationships between them. The “degree of improvement over efficient prediction” combined with directional accuracy are proposed in an estimation technique, as an alternative to the conventional least squares. Rejecting a claim that the accuracy of the forecast does not depend upon which error-criteria are used, profitability of networks trained with $L_6$ loss function appeared to be statistically significant and stable. The best economic performances are realized for a 1-year investment horizon with longer training not leading to enhanced accuracy. An improvement in profitability is achieved for models optimized with genetic algorithm. Computational intelligence is advocated for searching optimal relationships among economic agents’ risk attitude, loss function minimization in the learning process, and the profitability of trading decisions.
INTRODUCTION

A significant part of the financial research deals with identifying relationships among observed variables. Conventional financial modeling decided upon a mechanism (form, size, etc.) and searches for parameters that give the best fit between the observed values and the model’s solutions. Econometrics is supposed to direct the choice of the model’s functional form. Nevertheless, density assumption rests as a controversial and problematic question. Computational intelligence (CI) provides a general data mining structure, particularly suitable for complex nonlinear relationships in financial data, without a need to make assumptions about the data generating mechanism. Tailoring the desired output to the given input, CI tools determine the functional form of the model. However, CI tools are often viewed as “black-box” structures. Unlike the well-established statistical foundation of econometrics, a search for the foundation of CI tools in finance is in its early stages. This research is a step in the direction of examining the setup of an artificial neural network (ANN).

Similarly, problems with applications of evolutionary computation (EC) in economics and finance are often due to the lack of common methodology and statistical foundations of its numerous techniques. These deficiencies sometimes cast doubt on conjectured results and conclusions. At the same time, relationships between summary statistics used for predictions’ evaluation and profitability of investment decisions based on these predictions are not straightforward in nature. The importance of the latter is particularly evident for applications of an evolutionary artificial neural network (EANN) under supervised learning, where the process of network training is based on a chosen statistical criterion, but when economic performance is an overall objective.

The relationship between agents’ utility functions and optimal investment decisions is a long-standing issue in financial research. Recent development in computational economics and finance (CEF) allows me to address this question from a new perspective. This chapter aims to examine how investors’ preferences affect their behavior.

Advances in CEF also stimulate investigation of the relationship between investors’ time horizons and their actions. To date, most research considering time horizons in CEF deal with memory length. Agents’ time horizon heterogeneity with back and forward time perspectives has not yet been systematically examined. I examine how investors’ time horizons affect stock trading strategies.

Financial assets’ prices often exhibit nonstationarity, autocovariance and frequent structural breaks, posing problems for their modeling. This research also investigates how data mining benefits from genetic algorithm (GA) model discovery, performance surface optimization, pre- and postprocessing, thus improving predictability and profitability or both.

ECONOMIC AGENTS’ PREFERENCES AND INVESTMENT DECISIONS

It is common in analytical research to relate economic agents’ risk preferences and their decisions. This general approach has different realizations in supporting various “optimal” utility functions. It is often stated that for long-time investment it is optimal
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