

Chapter 7

Analysing the Returns– Earnings Relationship: Dempster–Shafer Theory and Evolutionary Computation Based Analyses Using the Classification and Ranking Belief Simplex

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ABSTRACT

This chapter considers the problem of understanding the relationship between company stock returns and earnings components, namely accruals and cash flows. The problem is of interest, because earnings are a key output of the accounting process, and investors have been shown to depend heavily on earnings in their valuation models. This chapter offers an elucidation on the application of a nascent data analysis technique, the Classification and Ranking Belief Simplex (CaRBS) and a recent development of it, called RCaRBS, in the returns-earnings relationship problem previously described. The approach underpinning the CaRBS technique is closely associated with uncertain reasoning, with methodological rudiments based on the Dempster-Shafer theory of evidence. With the analysis approach formed as a constrained optimisation problem, details on the employment of the evolutionary computation based technique trigonometric differential evolution are also presented. Alongside the presentation of results, in terms of model fit and variable contribution, based on a CaRBS classification-type analysis, a secondary analysis is performed using a development RCaRBS, which is able to perform multivariate regression-type analysis. Comparisons are made between the results from the two different types of analysis, as well as briefly with more traditional forms of analysis, namely binary logistic regression and multivariate linear regression. Where appropriate, numerical details in the construction of results from both CaRBS and RCaRBS are presented, as well emphasis on the graphical elucidation of findings.

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INTRODUCTION

In this chapter we describe the employment of a nascent analysis technique, utilising Dempster-Shafer theory and evolutionary computation, to examine the relationship between stock returns and earnings components, namely accruals and cash flows. The problem is of interest because earnings are a key output of the accounting process and investors have been shown to depend heavily on earnings in their valuation models (e.g. Imam *et al.*, 2008). Recent research, however, suggests that there are differences in levels of persistence of the cash flow and accruals components of earnings (e.g. Sloan, 1996), which, *ceteris paribus*, should lead to them being weighted differentially by stock markets.

The Classification and Ranking Belief Simplex (CaRBS) non-parametric soft-computing technique, introduced in Beynon (2005a, 2005b), was presented as a novel approach to data mining. The rudiments of CaRBS are based on the general methodology of Dempster-Shafer theory (DST), introduced in Dempster (1967) and Shafer (1976). It is considered one of the key mathematical approaches to uncertainty modeling (Roesmer, 2000). One consequence of the association of the CaRBS technique with DST is the ability to undertake analysis in the presence of a form of mathematical based ignorance (Safranek *et al.*, 1990; Beynon, 2005b).

The original CaRBS technique is here employed in a classification-type analysis, plus a development, termed RCaRBS (Beynon *et al.*, 2010), which facilitates regression-type analysis on the same problem. The RCaRBS analysis presented in this chapter illustrates, at the technical level, how a data analysis technique based on uncertain modelling, such as CaRBS, can be developed to undertake more general types of analysis, in this case multivariate regression. The chapter also describes how the configuration mechanics of the techniques are defined as constrained optimisation problems, solved here

using the evolutionary computation technique trigonometric differential evolution (TDE - Fan and Lampinen, 2003). Indeed, how the configuration processes are able to be adapted with the use of different objective functions with the TDE, depending on whether RCaRBS against CaRBS is being employed, is shown.

The rest of the chapter is organised as follows: The next section describes the methodologies employed, namely CaRBS, its development RCaRBS and TDE. This is followed by a description of the returns-earnings relationship problem that forms the basis of the analysis in this chapter. The following section presents the CaRBS and RCaRBS analyses of the returns-earnings relationship (along with logistic and linear regression results for benchmarking purposes), including the level of model fit and analysis of the contribution of the financial variables considered. Finally, future research directions and conclusions are drawn and the implications of the content of the chapter are discussed.

BACKGROUND

The Classification and Ranking Belief Simplex (CaRBS) technique was originally devised as a tool to undertake the binary classification and ranking of objects in the presence of ignorance (see Beynon, 2005a). The background discussed here surrounds the related technical issues, namely an exposition of the CaRBS technique and the development of it, called RCaRBS, which enables regression-type analyses to be performed (see Beynon *et al.*, 2010), and the power house methodology behind the necessary configuration optimisation, namely the evolutionary computation approach TDE.

The methodology underpinning the CaRBS technique is Dempster-Shafer theory (DST), introduced in Dempster (1967) and Shafer (1976), and generally acknowledged to be a mathematical approach associated with uncertainty modelling

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