



Chapter XIX

Financial Classification Using an Artificial Immune System

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Abstract

Recent years have seen a dramatic increase in the application of biologically-inspired algorithms to business problems. Applications of neural networks and evolutionary algorithms have become common. However, as yet there have been few applications of artificial immune systems (AIS), algorithms that are inspired by the workings of the natural immune system. The natural immune system can be considered as a distributed, self-organizing, classification system that operates in a dynamic environment. The mechanisms of natural immune systems, including their ability to distinguish between self and non-self, provides a rich metaphorical inspiration for the design of pattern-recognition algorithms. This chapter introduces AIS and provides an example of how an immune algorithm can be used to develop a classification system for predicting

corporate failure. The developed system displays good classification accuracy out-of-sample, up to two years prior to failure.

Introduction

Classification problems abound in business. Examples include decisions as to whether or not to invest in a firm, whether to extend trade credit to a new customer, or whether to extend a bank loan. In each of these scenarios the possibility of financial loss exists if a firm is incorrectly classified as being financially healthy when in fact it is not. This chapter introduces a novel methodology for classification purposes, the negative selection algorithm.

The negative selection algorithm is drawn from the literature of *artificial immune systems* (AIS), which in turn are inspired by the workings of the natural immune system (de Castro & Timmis, 2002). The natural immune system is a highly complex system, comprised of an intricate network of specialized tissues, organs, cells and chemical molecules. The natural immune system can recognize, destroy, and remember an almost unlimited numbers of pathogens (foreign objects that enter the body, including viruses, bacteria, multi-cellular parasites, and fungi). To assist in protecting the organism, the immune system has the capability to distinguish between self and non-self. Notably, the system does not require exhaustive training with negative (non-self) examples to make these distinctions, but can identify items that it has never before encountered as non-self.

The most commonly applied AIS can be grouped into three categories (see Figure 1), based on distinct features of the natural immune system. In this chapter we focus on the negative-selection algorithm. The object in designing and applying AIS is not to produce exact models of the natural immune system. Rather the objective is to extract ideas and metaphors from the workings of the natural immune system that can be used to help solve real-world problems. Artificial immune systems represent a relatively new class of algorithms and, as yet, few business applications of these algorithms have been developed. This chapter introduces AIS, and demonstrates their application by creating a classification system to distinguish between failing and non-failing companies.

The rest of this chapter is organized as follows. The next section provides an overview of the literature on corporate failure, followed by a section that introduces the natural immune system. We then outline the data set and methodology utilized in implementing the negative selection algorithm. The remaining sections provide the results of the study, followed by a number of conclusions.

Corporate Failure Prediction

Corporate failure can impose significant private costs on multiple parties including shareholders, providers of debt finance, employees, suppliers, customers and auditors. All of these stakeholders have an interest in being able to identify whether a company

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