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# A survey of credit and behavioural scoring: forecasting financial risk of lending to consumers

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## Abstract

Credit scoring and behavioural scoring are the techniques that help organisations decide whether or not to grant credit to consumers who apply to them. This article surveys the techniques used — both statistical and operational research based — to support these decisions. It also discusses the need to incorporate economic conditions into the scoring systems and the way the systems could change from estimating the probability of a consumer defaulting to estimating the profit a consumer will bring to the lending organisation — two of the major developments being attempted in the area. It points out how successful has been this under-researched area of forecasting financial risk. © 2000 International Institute of Forecasters. Published by Elsevier Science B.V. All rights reserved.

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## 1. Introduction

Forecasting financial risk has over the last thirty years become one of the major growth areas of statistics and probability modelling. When financial risk is mentioned one tends to think of portfolio management, pricing of options and other financial instruments (for example the ubiquitous Black–Scholes formula (Black & Scholes, 1973)), or bond pricing where Merton's paper (Merton, 1974) is seminal. Less well known but equally important are credit and behavioural scoring, which are the

applications of financial risk forecasting to consumer lending. An adult in the UK or US is being credit scored or behaviour scored on average at least once a week as the annual reports of the credit bureaux imply. The fact that most people are not aware of being scored does not diminish from its importance. This area of financial risk has a limited literature with only a few surveys (Rosenberg & Gleit, 1994; Hand & Henley, 1997; Thomas, 1992, 1998) and a handful of books (Hand & Jacka, 1998; Thomas Crook & Edelman, 1992; Lewis, 1992; Mays, 1998). The aim of this survey is to give an overview of the objectives, techniques and difficulties of credit scoring as an application of forecasting. It also identifies two developments

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in credit scoring where ideas from main-stream forecasting may help. Firstly there is a need to identify consumer risk forecasting techniques which incorporate economic conditions and so would automatically adjust for economic changes. Secondly, instead of seeking to minimise the percentage of consumers who default, companies are hoping they can identify the customers who are most profitable. Part of the catalyst for this development is the massive increase in information on consumer transactions which has happened in the last decade.

Credit scoring and behavioural scoring are the techniques that help organisations decide whether or not to grant credit to consumers who apply to them. There are two types of decisions that firms who lend to consumers have to make. Firstly should they grant credit to a new application. The tools that aid this decision are called credit scoring methods. The second type of decision is how to deal with existing customers. If an existing customer wants to increase his credit limit should the firm agree to that? What marketing if any should the firm aim at that customer? If the customer starts to fall behind in his repayments what actions should the firm take? Techniques that help with these decisions are called behavioural scoring

The information that is available in making a credit scoring decision includes both the applicant's application form details and the information held by a credit reference agency on the applicant. However there is also a mass of the information on previous applicants — their application form details and their subsequent performance. In many organisations such information is held on millions of previous customers. There is one problem with this information though. The firm will have the application form details on those customers it rejected for credit but no knowledge of how they would have performed. This gives a bias in the sample. This is a serious problem because if the firm says those it rejected previously would

have been bad this decision will be perpetuated in any scoring system based on this data and such groups of potential customers can never have the opportunity to prove their worth. On the other hand there are usually sound reasons for rejecting such applicants and so it is likely that the rejects have a higher default rate than those who were previously accepted. Whether one can impute whether the rejected customers will be good or bad has been the subject of considerable debate. The idea of 'reject inference' has been suggested and used by many in the industry. Hsia (1978) describes the augmentation method while other approaches are suggested in Reichert, Cho and Wagner (1983) and Joanes (1993). Hand and Henley (1993) in a detailed study of the problem concluded that it cannot be overcome unless one can assume particular relationships between the distributions of the goods and the bads which hold for both the accepted and the rejected population. One way around it, is to accept everyone for a short period of time and to use that group as a sample. What firms do seems to depend as much on the culture of the organisation as on any statistical validation. Retailers and mail order firms tend to accept all applicants for a short period of time and use that group to build scorecards. Financial institutions on the other hand are swayed by the cost of default and feel there is no way they can accept everyone, even for a trial, and so use versions of reject inference.

In the next section we review the history of credit scoring. Then we examine the way credit scoring works and a general overview of the techniques that are useful in building credit scorecards. The fourth section gives a similar overview of behavioural scoring while the subsequent sections look at two proposed extensions of credit scoring which could give more robust and more focussed scorecards. The first extension tries to introduce dependence on economic conditions into credit scoring, while

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