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Using a rolling training approach to improve judgmental extrapolations elicited from forecasters with technical knowledge

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ABSTRACT

There are several biases and inefficiencies that are commonly associated with the judgmental extrapolation of time series, even when the forecasters have technical knowledge about forecasting. This study examines the effectiveness of using a rolling training approach, based on feedback, to improve the accuracy of forecasts elicited from people with such knowledge. In an experiment, forecasters were asked to make multiple judgmental extrapolations for a set of time series from different time origins. For each series in turn, the participants were either unaided or provided with feedback. In the latter case, the true outcomes and performance feedback were provided following the submission of each set of forecasts. The objective was to provide a training scheme that would enable forecasters to understand the underlying pattern of the data better by learning from their forecast errors directly. An analysis of the results indicated that this rolling training approach is an effective method for enhancing the judgmental extrapolations elicited from people with technical knowledge, especially when bias feedback is provided. As such, it could be a valuable element in the design of software systems that are intended to support expert knowledge elicitation (EKE) in forecasting.

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1. Introduction

Surveys suggest that forecasts based either wholly or partly on expert management judgment play a major role in company decision making (e.g., Fildes & Goodwin, 2007). Sometimes these judgmental inputs take the form of adjustments to statistical forecasts, ostensibly to take into account special factors that were not considered by the statistical forecast (Fildes, Goodwin, Lawrence, & Nikolopoulos, 2009). However, in some circumstances, judgment may be the only process involved in producing the forecasts. At times, there is even a statistical forecast provided, but the expert chooses to ignore it (Franses, 2014). In some cases, judgment is used to extrapolate time series data to produce point forecasts, when no other information (except perhaps variable labels such as 'sales' or 'costs') is provided. This type of task has been the subject of much research over the last thirty years, and a number of biases associated with judgmental extrapolation have been identified. These include tendencies to overweight the most recent observation (e.g., O'Connor, Remus, & Griggs, 1993, to underestimate the growth and decay in

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series (Lawrence, Goodwin, O'Connor, & Onkal, 2006), and to see systematic patterns in the noise associated with series (Eggleton, 1982; O'Connor et al., 1993).

Such biases can apply even when the forecaster has expertise, whether in the domain within which the forecasts are being made (e.g., Pollock & Wilkie, 1993) or in forecasting itself (Goodwin & Fildes, 1999). This suggests that, when experts are called upon to make judgmental extrapolations, the elicitation process may benefit from the inclusion of devices that are designed to mitigate these biases. Studies in the expert knowledge and elicitation (EKE) literature have examined a number of ways of designing elicitation methods so as to reduce the danger of biased judgments from experts, particularly in relation to the estimation of probabilities or probability distributions Aspinall, 2010; Bolger & Rowe, 2014; Goodwin & Wright, 2014, Morgan, 2014, Chapter 11). Our focus here is on improving EKE in time series extrapolation.

A variety of strategies have been explored in an attempt to mitigate biases in the elicitation of judgmental extrapolations (Goodwin & Wright, 1993). One promising strategy is to use performance feedback to train forecasters who already have technical expertise in order to improve the accuracy of their extrapolations (Lawrence et al., 2006). The use of feedback to enhance the quality of expert judgments has proved to be successful in other areas of EKE, such as weather forecasting (Murphy & Winkler, 1977), as well as in applications of the Delphi technique, where the feedback relates to the judgments of other experts (Rowe & Wright, 1999). In time series extrapolation, while some studies, such as that of Goodwin and Fildes (1999), have shown that feedback can lead to improvements in the accuracy of point forecasts, more research is needed to identify the most effective form of feedback for improving the accuracy. This is a particularly important topic in demand forecasting, where software provides the expert with information on past errors.

This paper reports on an experiment that was designed to examine the effectiveness of providing forecasters with rolling feedback on both the outcomes of the variable that they are attempting to predict and their forecasting performance. The objective is to provide a direct training scheme, thus enabling forecasters who already have technical knowledge to understand the underlying pattern of the data better by learning from their forecast errors directly, thus improving the accuracy of their judgments. Two types of performance feedback were compared: feedback on the bias associated with the forecasts submitted, and feedback on their accuracy. The paper is structured as follows. First, a review of the relevant literature is presented. Details of the experiment and the analysis and results follow. Finally, the practical implications of the findings are discussed, and suggestions are made for further work in this area.

2. Literature review

In judgmental forecasting, Sanders and Ritzman (1992) distinguish between expertise that is founded on contextual knowledge and that which is based on technical knowledge. Expertise relating to contextual knowledge comes from factors such as experience working in an industry or the possession of specific product knowledge. In contrast, expertise based on technical knowledge is present when a forecaster has a knowledge of formal forecasting procedures, including information on how to analyze data judgmentally.

Sanders and Ritzman compared the forecasting accuracies of: (i) managers who had contextual expertise but lacked technical expertise, (ii) forecasters who lacked contextual expertise but had technical expertise, and (iii) forecasters who lacked both contextual and technical expertise. They concluded that expertise based on technical knowledge had little value in improving the accuracy of judgmental forecasts relative to expertise based on contextual knowledge. However, many of the time series that they studied were highly volatile, and contextual factors, rather than time series components, accounted for much of their variation. The forecasters with technical expertise who took part in the study were not privy to these contextual factors.

A comparison of the forecasts of people in groups (ii) and (iii) enabled the authors to assess whether forecasters who were lacking in contextual expertise but educated in such technical aspects as the handling of outliers, the identification of trends and the avoidance of judgmental biases were able to achieve higher levels of accuracy than those who lacked such knowledge. The authors reported that there was little difference in accuracy, and therefore concluded that providing people with technical expertise had no value. However, a close inspection of their results reveals that this finding only holds for the five most volatile series in the study (those with a coefficient of variation exceeding 134%). If these series are excluded, forecasters with technical knowledge had lower average median absolute percentage errors (MdAPE) than those without this knowledge in 13 series out of 17 ($p = 0.025$ on a binomial test of the hypothesis that each group had an equal probability of achieving the lowest MdAPE on a given series). Although the mean reduction in average MdAPEs for the 17 series was only 1.8%, the results provide some evidence that, when series do not demonstrate extreme volatility, there may actually be advantages in eliciting forecasts from people who possess technical expertise. This also suggests that it may be possible for these judgments to be enhanced through further training.

In a review of Sanders and Ritzman's (1992) study, Collopy (1994) argues that people may not always be able to apply what they learn in a training process. He cites a report by Culotta (1992), who found that even students who do well in calculus courses cannot apply what they have learned. In Sanders and Ritzman's study, those who were counted as having technical knowledge had taken an elective course in forecasting, and may therefore have been subject to didactic learning, which is a relatively passive process. This is in contrast to experiential learning, which includes actively participating in the task for which one is being trained, reflecting on the experience, and learning from feedback (Moon, 2004). Thus, training of this type may be effective in obtaining improvements in accuracy for those with technical expertise.

In order for experiential training to be effective, it needs to address the specific challenges of the task

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