2e

Principles of Business Forecasting

Keith Ord | Robert Fildes | Nikolaos Kourentzes

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Business forecasting is art woven into science and principle teamed with pragmatism. Virtually every manager has to make plans or decisions that depend on forecasts. Research over the past 50 years or more has shown that taking an analytical approach rather than just relying on informal intuition leads to more accurate forecasts and more effective plans and decisions. However, forecasting is often the poor relation of more theoretical material, available through courses in regression, and time series analysis.

This book not only provides an introduction to both standard and advanced approaches to forecasting, but also presents general principles that underlie forecasting practice. What makes this book unique is its emphasis on incorporating the latest research findings to help practicing forecasters carry out their job and to enable students to prepare for a managerial or analytical career.

brief contents

*Advanced topic

about the authors

Keith Ord is Professor Emeritus in the Operations and Information Management group at the McDonough School of Business at Georgetown University. He completed his graduate work at the University of London and held faculty positions at the Universities of Bristol and Warwick before moving to The Pennsylvania State University in 1980 and then to Georgetown University in 1999. His research interests include time series and forecasting, spatial modeling and the statistical modeling of business processes. He is a co-author of the 2008 research monograph Forecasting with Exponential Smoothing: The State Space Approach and also co-authored Kendall's Advanced Theory of Statistics. He has served as an editor of the International Journal of Forecasting and is currently on the editorial boards of several other journals. Keith is a Fellow of the American Statistical Association and of the International Institute of Forecasters.

Robert Fildes is Distinguished Professor of Management Science in the Management School, Lancaster University and Founding Director of the Lancaster Centre for Marketing Analytics and Forecasting. He has a mathematics degree from Oxford and a Ph.D. from the University of California in Statistics. He was co-founder in 1981 of the *Journal of Forecasting* and in 1985 of the *International Journal of Forecasting* (IJF). For ten years from I988 he was Editor-in-Chief of the IJF and remains an associate editor. He was president of the International Institute of Forecasters between 2000 and 2004. His research interests are concerned with the comparative evaluation of different forecasting methods, the implementation of improved forecasting procedures in organizations and the design of forecasting systems. In 1976 he wrote one of the earliest business forecasting textbooks. Though long out-of-print, many of its core ideas have survived the test of time to surface again here in a more modern guise. Robert is a Fellow of the International Institute of Forecasters and of the UK Operational Research Society. In 2014 he was awarded the Beale Medal from the UK OR Society, its highest accolade.

Nikolaos Kourentzes is an Associate Professor in the Department of Management Science at Lancaster University Management School. His background is in Strategic Management, but quickly changed his interests to Management Science, with a Ph.D. from Lancaster University in forecasting with neural networks. He is on the editorial board of the *International Journal of Forecasting* and founding member of the Forecasting Society. Nikos' primary research interest is modeling uncertainty in a business forecasting context, whether that concerns model specification and selection, or ways to make forecasts more reliable and robust. His research addresses forecasting issues of aggregation and hierarchies, model combination, promotional modeling, and supply chain collaboration. He has published multiple forecasting related open-source packages for R, in his attempt to bring current forecasting research to practice.

sample pages

each chapter opens with a detailed table of contents showing the subject matter contained therein

CHAPTER 1

Forecasting, the Why and the How

Table of Contents

coverage includes exponential smoothing and ARIMA, regression modeling, extensive use of R

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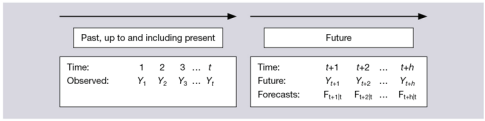
ose a poor statistical model, you will get poor forecasts and poor inty — maybe not always, but on average.
ocus primarily on methods. These methods will be underpinned by ve introduce in Chapter 5. On the basis of these models, we are able intervals, which we do in Section 3.8.

3.2 Extrapolative Methods

Extrapolative methods of forecasting focus on a single time series to identify past patterns in the historical data. These patterns are then extrapolated to map out the likely future path of the series. The overall structure is shown in Figure 3.1.

Figure 3.1 is to be interpreted as follows: We denote the particular series of interest (e.g., weekly sales) by *Y*. We have recorded the observations $Y_1, Y_2, \ldots, Y_t$ over *t weeks,* which represent all the data currently available. Our interest lies in forecasting sales over the next *h* weeks, known as the *forecasting horizon;* that is, we are interested in providing forecasts for future sales, denoted by $Y_{t+1}, Y_{t+2}, \ldots, Y_{t+h}$.

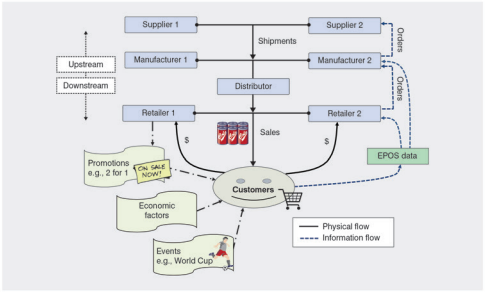
Figure 3.1 General Framework for Forecasting with a Single Series



forecasting practice in operations and marketing

Chapter 12 Putting Fore

Figure 12.4 Forecasting across the Supply Chain



life more difficult. Essentially, the first step when one is forecasting must be to "clean" the data. In operations, the process must usually be automatic so that corrections are put in place for a retailer to take into account lost sales due to the item's being out of stock or the effect of returns. A typical cor… to estimate demand as

$$\ldots \times \text{Stock}.$$

Chapter 3 Forecasting Non-Seasonal Series 93

he hold-out sample. We then choose the method that corresponds to the selected criterion (*RMSE, MAE, MAPE, MdAPE,* etc.), calculated over the sample of h… eries. We return to the issue of method selection in Chapter 5 (Section 5.3), in which the analysis is reinforced by the development of underlying statistical models.

each chapter closes with a set of principles to guide forecasting practice

3.10 Principles of Extrapolative Methods

To avoid undue repetition, we assume that the data series being forecast is appropriate for the problem at hand in terms of relevance, timeliness, and reporting accuracy. These assumptions are by no means trivial, but we have discussed them in the previous chapters and they remain critical to any forecasting exercise. We should always recall the maxim "Garbage in, garbage out." If the data do not satisfy the aforementioned criteria, further analysis may be useless. As before, Armstrong (2001) is a valuable resource, and many of the principles quoted reflect his ideas. A few principles are repeated from Chapter 2 because they are an integral part of the forecasting approach described in the current chapter.

[3.1] Plot the series.
Data plotting should be the first step in any analysis. If a large number of series is involved, plot a selection of them. Such plots will often serve to identify data-recording errors, missing values, and unusual events.

[3.2] Clean the data.
Data plots and simple screening procedures (checks for outliers) provide the basis for making adjustments for anomalous values. Make sure that the adjustments are for valid data-recording reasons, an… such changes.

…bout the process

"*Principles of Business Forecasting* is in my opinion the most readable book in the field, and I think I own all of them. The authors of the first edition are eminent researchers, both known for clear writing which is on display here. They have been joined in the second edition by Nikos Kourentzes who has added new ideas and R based tutorials, the aim being to make the book more widely usable in applications. … One novel feature is the emphasis on evidence-based principles of forecasting rather than quantitative modeling. That is, modeling is used to support the principles; for some years, I have tried to teach this way, but I have never had a text to support me. …"

Everette S. Gardner, Jr., Ph.D.
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Bauer College of Business, University of Houston

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structure of the book

Introduction – Chapters 1–2

Extrapolative methods – Chapters 3–6

Statistical model building – Chapters 7–9

Advanced methods and forecasting practice – Chapters 10–13

use of the book

Most readers will have had the benefit of a first course in applied statistics, or an equivalent background, although a brief refresher of key statistical methods is included in Chapter 2 (and online Appendix A). Our aim in the book is to show users how to forecast (and that forecasting is fun). The book is designed for students in management science, statistics and business analytics as well as all practicing forecasters.

key innovations in the second edition

The second edition embodies some key changes:

- R programs and tutorial material are provided so that all analyses can be carried out (for free!) wherever the user is working.
- Expanded coverage of model building in regression.
- New material on judgment to address some of the political shocks in the last few years.
- Greater coverage of data analytics, in particular neural nets together with software.
- Expanded material on applications that uniquely includes new research findings relevant and immediately applicable to operations, such as hierarchical modelling and temporal aggregation.
- A new colleague, Nikolaos Kourentzes to join the authoring team with complementary expertise, particularly in R.
- Updated data sets.

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