Getting the best out of forecasting software

Robert Fildes
Professor, Department of Management Science
Centre for Marketing Analytics and Forecasting

Nikolaos Kourentzes
Professor, Department of Management Science
Centre for Marketing Analytics and Forecasting

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Services
• Short courses (open & bespoke)
• Consultancy
• MSc summer projects
• Software development
• Knowledge-transfer partnerships
• PhD research projects

Expertise
• Marketing analytics
• Supply chain forecasting
• Forecasting & planning processes
• Machine learning

*Applied in a wide variety of sectors (eg FMCG, govt, pharma)*

Prof John Boylan, Dr Sven Crone, Dr Florian Dost, Prof Robert Fildes, Dr Nikolaos Kourentzes, Dr Nicos Pavlidis, Dr Ivan Svetunkov
Who’s forecasting? Why is software important?

- Analysts
- Demand planners
- Software suppliers
- Researchers

Application areas

The Diffusion of Forecasting Research into Practice

The dotted arrows show weak links

Forecasting software: the issues

• Identifying a list of requirements
  – Matching the software to the job

• Choosing the right software
  – Must have
  – Like to have
  – The software source/ supplier

• Getting the best from the chosen software
The process of organisational forecasting

The Forecasting Process: A Task-Analytic Perspective
A stylised view of producing a forecast

1. Define Data base
2. Define Data base + revisions
3. Select a range of forecasting methods
4. Select & estimate/revise forecasting model
5. User reconciliation: e.g. Logistics supply shortages
6. Market intelligence (MI)
7. Functional forecasts (FF): Advice
8. Combine forecasts using MI and FF

Two forms of information:
- MI
- Advice
Key elements

• Selection
  – Short-listing
    • What job is to be done
  – Open source (R, Python) vs proprietary (SAS, IBM)

• Tuning for organizational forecasting
  – So you’ve spent £1M; it’s producing forecasts for operations: now what?

• Incorporating judgment (MI)
Types of software: The OR/MS survey

- 100+ forecasting software products identified
- 20 respondents: now on-line updating
- Survey biennial for 20 years

- General Purpose Statistical
- Specialist forecasting
- Econometric
- Forecasting support systems
  - Demand planning/ call centre
- Mathematical/ statistical languages
  - R, Python, MATLAB

Choosing the type of software

• So what’s wrong with Excel?

• Need to match organizational processes
  • The users’ expertise?
  • The data
  • One-off vs operational forecasting

• Open source vs proprietorial

Discussion question: What are the current issues?
Benchmarking organisation’s forecasts

- Sample of time series
  - Actuals
  - Statistical forecasts + judgmental adjustments

- Competitive methods
  - In an ideal world
  - In the real world as is
  - Forecast Value added (from judgmental adjustments)?

- Agreed accuracy measures
  - Out-of-sample rolling origin
  - Avoid sensitivity to ‘outliers’ e.g. data near zero
    - (Davydenko and Fildes, in Gilligand et al., Business Forecasting, Wiley & SAS)
  - Match with decision problem (aggregation, forecast horizon)
  - Segmentation and monitoring

*It’s ‘horses for courses’!*
How are forecasts typically produced?

Even in macroeconomic and weather forecasting, judgment is added to a (complex) statistical model.
How are forecasts typically produced?

Benchmark extrapolative statistical forecast

Causal model forecast

Selection and parameter tuning, e.g. seasonal model, smoothing parameter

Explanatory variable/Special events

Final forecast
Improving the process

- Improving on default automatic settings
  - Benchmark against: naïve, other software.
  - Improving setup within existing software.

![Percentage Error Chart](chart.png)
Improving the process

- Current SAP-APO
  - Evaluate accuracy: statistical vs ‘final’ gives value added
  - Only some judgmental adjustments increase accuracy

![Graph showing relative adjustment size vs MAPE error percentage]

- Monthly data (MAPE)
  - Judgmental Gain
  - "Forecast Value Added"
  - Final adjusted Forecast error
  - Statistical System Forecast error

125% improvement
10% improvement
No improvement
Improving the process – model choice

Current (e.g., SAP APO automatic)
- Modify parameters and method choice algorithms (within SAP)
- Accuracy Improvements? Sanofi-Aventis gains are 35%

Implementation
- Modified SAP + choice algorithm
- Judgmental feedback on value added
  - Fewer adjustments (only with substantive knowledge)

Benefits (Sanofi-Aventis)
- Fewer adjustments, fewer meetings!
- $3M savings
- Improved service to customers
Factors affecting the use of different forecasting methodologies

Choice of methodology affects:
- the forecast error rate.
- the acceptability of the final forecast to users.
Software dimensions

• Software and hardware requirements

• Data handling
  • Integrates with other programming languages (e.g., R)

• Forecasting features
  • Selection of estimation and hold out
  • Rolling origin evaluation
  • Error measures
  • Benchmark forecasting e.g., random walk
  • Multiple seasonalities
  • Prediction intervals

• Hierarchical forecasting

• Judgmental forecasting/ adjustments
Software dimensions

• Exploratory analysis and graphics
  • Time series and seasonal plots
  • Autocorrelation
  • Transformations
  • Decomposition (into trend, seasonal and noise: Census X-13 ARIMA)
  • Explanatory variables

• Forecasting methods
  • Exponential Smoothing methods and ETS models
  • ARIMA
  • Intermittent demand
  • Growth and diffusion curves
  • Regression (Lasso)
  • Machine learning and AI
Can we get software cheap?

- Open source: zero cost (?)
  - Support
  - Licenses
  - Open source ethics!

- Quality of implementation and scalability

- State-of-the art
  - Often packages are from inventors of methods/models
  - Designed for research and/or production systems?
Forecast as a service

- Outsource forecasting
  - Specialist companies/consultants
  - Online services (e.g. Amazon)

- Transparency of forecasting?
  - Appropriate models/methods or forced to what is available?
  - Integration with in-house expertise and use of soft information?

- Cost
  - Running cost
  - Organisation cost – analytics as a competitive advantage
Choosing the supplier

• Must haves
• Would likes
• Technical requirements
  • Input limitations
  • Computational limitations (e.g. for the retailer, 40K SKUs x 400 stores, daily)

• Validity of methods and comparative accuracy
• Support
  • Technical
  • Training
• Price!
Centre for Marketing Analytics and Forecasting (forecasting-centre.com)

CMAF R forecasting packages:
- **MAPA**: forecasting with multiple temporal aggregation;
- **thief**: forecasting with temporal hierarchies
- **nnfor**: (shallow) neural networks for time series forecasting
- **smooth**: ETS and ARIMA (incl. high frequency data and explanatory variables)
- **tsintermittent**: forecasting intermittent series
- **diffusion**: life-cycle modelling
- **TStools**: supporting functions for time series modelling (available on Github)
- **greybox**: supporting functions for time series modelling
- **GTT**: handle Google Trends data
Take-aways

• Software choice must match organizational processes
  • Data
  • People
  • Decision requirements

• Software quality variable!
  • Models must be benchmarked & tuned

• Managerial intervention a key feature of forecasting
  • Model selection
  • Parameter tuning
  • Adjustments

Delivering the final forecast
Thank you for your attention! Questions?

Robert Fildes
email: r.fildes@Lancaster.ac.uk

Nikolaos Kourentzes
email: nikolaos@kourentzes.com
twitter @nkourentz
Blog: http://nikolaos.kourentzes.com

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