Forecasting Practice: Decision Support System to Assist Judgmental Forecasting

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Abstract

This paper presents a *Forecast Tracker* that can help bridge the wide gap between formal econometric forecasting methods and the common practice of judgmental forecasting. Traditionally, out-of-sample forecast errors have been widely used to improve the accuracy of econometric models, but track records of judgmental forecasts have had little systematic impact on the way those forecasts are being produced. The *Forecast Tracker* system presented in this paper is meant to be an integral part of a judgmental forecasting process by providing the forecaster with essential statistical information that attempts to reveal the rules of thumb that the judgmental forecaster is implicitly using. The *Forecast Tracker* is based on a two stage design algorithm that initially stores forecasts and thereafter provides useful metrics to aid judgmental forecasting. A customized version of the *Forecast Tracker* has been implemented using the softwares: AREMOS ® and Microsoft Excel®.

1 Introduction

The art of economic forecasting has been receiving growing attention due to its ability to show visible improvement in a company's business policies for the future. Every forecasting unit is seeking to harness all available information, both in terms of statistical data from its models, as well as the individual expertise of the *forecaster*, with the aim of providing a better prediction. A concurrent development in the field of information technology has been in the designing of what are today termed as *decision support systems*. As the name suggests, these systems *support* decision-making units by incorporating computational systems in the overall business practice. Given this scenario, current research focusses on developing newer and more efficient *decision support* systems for better forecasting. In this paper, we present such a system, *The Forecast Tracker*, that serves as an aid in bridging the gap between 'purely statistical' and 'judgmental' forecasting.

2 Forecasting Methods

From the perspective of this paper, forecasting methods can be classified into two very broad categories:

- Statistical Method: In this method, the forecasting is performed using standard statistical models that are usually based on historical data. The amount and accuracy of available data is often critical to the performance of such models.
- Judgmental Method: In this method, the forecast is either entirely based on the judgement of the forecaster or that the forecaster provides judgmental modifications to the results of the statistical method. A lot of organizations often rely heavily only on some form of judgmental forecasting.

Goodwin [1] elaborates in detail the methods that could be used to integrate the statistical and judgmental sides of forecasting. He suggests that systems that provide *voluntary integration* of the two methods are most useful for short-term forecasting. Previously, in 1999, Goodwin and Fildes [3] had shown that statistical forecasts improve *judgment* under certain conditions. They also found that judgmental forecasters often make far from optimal use of newer information.
The *Forecast Tracker* aims to provide the judgmental forecaster with relevant statistical information that can be used in various ways. Bowman and Husain [4] have analyzed three models for forecasting of commodity prices by using statistical measures for comparison. They have shown that the model based entirely on historical data is not the optimal model for the

analyzed situation. The *Forecast Tracker* builds upon such evidence and tries to provide a *voluntary integration* system wherein the forecaster can observe the data so as to aid the decision of *exercising* or *restraining* from a judgmental modification to a statistical forecast. We shall discuss details of the *Forecast Tracker* in Section (4).

3 Performance Evaluation

In addition to its ability of providing for *voluntary integration*, the *Forecast Tracker* also aids in assessing the performance of forecasts.
An evaluation procedure, commonly referred to as the *post-mortem*, is usually performed to validate the accuracy of forecasts. This *ex-post evaluation* is done *after* actual data of the predicted items is available. For example, in 1998, Jos Verbeek [5] presented a detailed analysis of World Bank's Unified Survey Predictions from 1991 to 1997 by specifically addressing questions of forecast accuracy. In 2001, Artis and Marcellino [6] performed a post-forecast analysis on predictions for the government deficit of G7 countries as done by the IMF, the OECD and the EC. In both these papers, performance has been judged on the basis of traditional metrics such as root mean squared error, mean absolute error, etc.
In the present environment of competition amongst forecasting units, the *Forecast Tracker* offers the ability to perform elementary performance evaluation as soon as historical data is available. In the next sections, we shall discuss the design and functioning of the *Forecast Tracker*.

4 The Forecast Tracker

The *Forecast Tracker* is a decision support system that relies on a two stage designing algorithm. In the first stage, the system *stores* newer data and recent forecasts, or performs what we shall henceforth refer to as *archiving*. In the second stage, performance metrics are calculated, elementary forecasts are generated and these are displayed at a user-interface.

4.1 Design Procedure

In this section, we shall elaborate on the actual designing of the system and its implementation using commercially available softwares.

4.1.1 Archiving

The *Forecast Tracker* is designed to keep a *archived* copy of every forecast made by the unit. In the present form of the system implementation, this *archiving* was done using a commercially available time-series based statistical software known as AREMOS. The historical data is stored as is,

while forecast data is initially *time stamped* and thereafter stored as a series. In AREMOS, the *time stamping* can be done by attaching a suffix to the series, for example, the forecast for a monthly data series of GDP for the United States that has been performed in February 2005 can be stored as *USAGDP.2005M02* Elementary forecasts as well as performance metrics are then calculated, suitably time-stamped and thereafter stored. All the historical as well as forecast data is stored in a single large *archive bank* that can be accessed by the user interface.

4.1.2 User Interface Display

The *front-end* or the display of the *Forecast Tracker* has been implemented using MS Excel. Using a plug-in that allows interfacing between AREMOS and MS Excel, the *Forecast Tracker* extracts the data from the archive bank. Using the highly customizable graphing ability of MS Excel, the *Forecast Tracker* displays useful graphs for the forecaster. These include basic plots such as data trends in terms of growth rates, together with performance evaluation metrics such as RMSE, MAE and other directional accuracy metrics. MS Excel uses Visual Basic macros for customizing the view of the graphs.

4.2 Features of the Forecast Tracker

As discussed above, it can be seen that the *Forecast Tracker* design is customizable for every unique forecasting environment. The visual interface for the *Forecast Tracker* is shown in figure (1). The drop-down menus are used for custom selection and the Visual Basic macros help dynamically update the charts.

4.3 Forecast comparison metrics

A significant component of the *Forecast Tracker* is the ability to provide performance metrics *on-the-fly*. The presently implemented version of the *Tracker* provides a display of the following metrics:

- **RMSE and MAE**: As is done in most *ex-post* forecast evaluation studies (for eg: [4], [5] and [6]), the Root Mean Square Error and the Mean Absolute Error for a particular price series is displayed. The *Tracker* uses different series of projections for the same indicator to calculate these metrics.
- **Time-distance**: The concept of *time-distance* as a metric to evaluate forecasting accuracy was introduced by Granger and Jeon [7]. This metric describes forecast accuracy in terms of the *horizontal distance* between the forecast and the actual value of the series. The *Tracker*

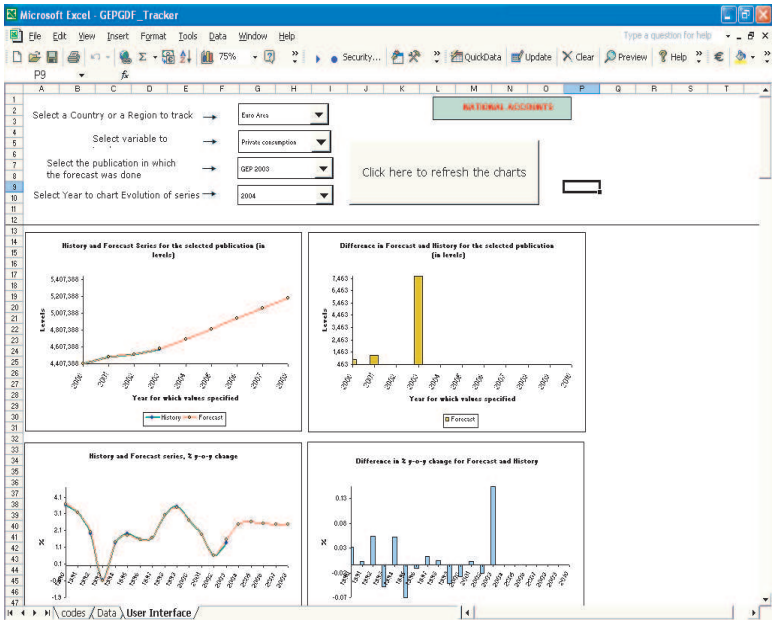

Figure 1: Visual Interface

implements a version of the time-distance metrics. This could prove to be useful in visualizing for directional accuracy of the forecasts.

- **Naive forecasts**: This component of the *Tracker* calculates simple linear forecasts using readily available quantities. For example, a elementary forecast for a high frequency monthly series can be calculated by using the previous quarter growth rate to project the data series ahead in time. These naive forecasts can be used by forecasters who use complex models to find a quick estimate without extensive computation.

4.4 Advantages of the Tracker

The *Forecast Tracker* serves as a decision support system with the following distinct advantages:

- **Simple design algorithm**: The *Tracker* uses a simple two-stage designing algorithm for its entire functioning. The design is implementable with most data-handling software. The present version of the *Tracker* uses AREMOS and MS Excel.

- **Ease in customization**: The *Tracker* can be adapted to every unique forecasting situation. It is presently equipped to work with data series having monthly, quarterly and annual frequency.

- **Aid for Judgmental Forecasting**: The *Tracker* displays historical data together with naive forecasts that are helpful in judgmental forecasting.
- **Aid for Performance Evaluation**: The performance metrics such as RMSE, MAE and *time-distance* provide the forecaster with performance evaluation metrics *on-the-fly*.

5 Behavior of Forecasters

An aspect of the *Forecast Tracker* that is presently under investigation is its ability to *discover* the behavior of forecasters. An interesting behavioral aspect of professional forecasters has been described by Pons-Novell [8], where he seeks to explore *herding behavior* of forecasters. However, our attempts to understand behavior are more with respect to *information availability responses* of forecasters.

In an attempt to explore the behavior of forecasters when newer information is made available, a further customized version of the *Tracker* has been implemented. A typical situation in any forecasting environment involves generating projections of a certain series that has a large number of distinct factors influencing it. For example, we know that the forecast for a specific region of the world is often related to the forecast of surrounding regions affecting that economy. Most often, individual forecaster (*region experts*) handle independent region forecasting. The forecasting procedure involves extensive deliberations between these individuals which results in *newer information* for the forecaster. This *newer information* could be actual new data or be something like a *judgmental forecast* that seems to preserve the overall forecasting structure. Our version of the *Tracker* is able to archive these judgmental forecasts and illustrate the changes in the projections due to newer forecasts.

The *Forecast Tracker* has been integrated into the work-flow of the Development Prospects Group of the World Bank, Washington, DC. Though the preliminary observations regarding the behavior of forecasters is indicative of their adherence to *rules of thumb*, there is not enough data to make conclusive statements.

6 Conclusion

As discussed in this paper, the *Forecast Tracker* is an attempt to bridge the gap between *statistical* and *judgmental* forecasting. It provides *on-the-fly* performance evaluation by the visual display of error metrics. The simple design algorithm and easy scalability help the *Tracker* integrate itself in

every forecasting environment. Presently, efforts are underway to customize the *Tracker* to study the behavior of forecasters.

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