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Software review

Commercially available software and the M3-Competition

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One of the most gratifying effects of earlier competitions has been the extent to which the leading forecasting software vendors have used the conclusions to enhance their products. Accordingly, a number of vendors were invited to participate in the M3-Competition. Five ultimately did so, and brief descriptions of their system capabilities are provided below. They are, in alphabetical order:

- AutoBox (Automatic Forecasting Systems)
- Forecast Pro (Business Forecast Systems)
- ForecastX (John Galt)
- PP Autocast (Delphus)
- SmartForecasts (Smart Software).

The AUTOBOX system

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AUTOBOX is an automatic forecasting system for Transfer Function modeling with a number of key options that may be specified by the user. A Transfer Function can include user specified exogenous, input or helping series. It can also include ''evidented'' Intervention Variables needed to explain or model the observed time series. In the analysis for the M3 competition, three variants were considered. The three methods used a particular approach for all series.

1. ARIMA-only

ARIMA modeling is conducted without any Intervention Detection. AUTOBOX matches the sample ACF with theoretical ACF's for alter-

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native ‘‘starting models’’ and selects the model using AIC criteria. It then adds and deletes (sufficiency and necessity tests) until a resolved model generates a white noise error process and all coefficients in the model are statistically significant.

1.1. Conditions under which the method will do well

ARIMA-only does well when the omitted stochastic series behave consistently with their past and there are no unusual values, i.e. interventions, in the history. Such interventions are described in Section 2 below.

ARIMA extends history into the future by extrapolating the signal. If the future does not behave as it should have, don’t blame the past just blame the rear-view mirror approach to use history as a surrogate for causals. ARIMA models are a poor man’s regression and sometimes they perform poorly when the true-cause variables are ignored.

2. ARIMAINT: ARIMA-then-interventions

The steps in (ARIMA) are followed, but before the heuristic concludes its tests for the constancy of the mean of the errors. While the inclusion of a constant term in an ARIMA model guarantees that the mean of the residuals overall is zero, it does not guarantee that the mean is zero everywhere. This aspect of the Gaussian assumptions is verifiable by examining the residuals for four kinds of possible auxiliary variables, as listed below:

Pulse: an unusual value
Seasonal Pulse: an unusual value that becomes usual as it arises every ‘S’ periods.
Level Shift: a sequence of pulses each with approximately the same sign and magnitude (Step Shift)
Local Time Trends: a sequence of residuals that monotonically increase or decrease for some period of time.

In summary, ARIMA modeling is conducted with Intervention Detection being used after the initially identified ARIMA process. Intervention Detection included searching for Pulses, Seasonal Pulses, Level or Step Shifts or Local Time Trends.

2.1. Conditions under which the method will do well

ARIMAINT does well when the omitted stochastic series behave consistently with their past and there are unusual values as indicated by the auxiliary variables described above and the dominant structure is memory. If Intervention Variables represent the dominant effect then this approach can lead to biased identification of the ARIMA component and possibly bad forecasts will ensue. Approach 3 pursues model construction by identifying the Intervention Variables first and then augmenting the model with identified ARIMA structure.

3. INTARIMA: interventions-then-ARIMA

As in approach 3 the residuals (this time from the simple mean) are examined for four kinds of possible auxiliary variables. After incorporating these effects the new set of residuals are examined for autocorrelative patterns as in ARIMA leading to an ARIMA formulation and subsequently a joint model.

3.1. Conditions under which the method will do well

INTARIMA does well when the omitted stochastic series behave consistently with their past and there are unusual values as indicated

by the auxiliary variables described above and the dominant structure is Intervention Variables (described in 2). Approach 3 pursues model construction by identifying the Intervention Variables first and then augmenting the model with identified ARIMA structure.

The Forecast Pro methodology

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Forecast Pro is an off-the-shelf product of Business Forecast Systems (BFS), one of the five commercial entrants in the M3 competition. This article provides details about the product as it was configured for the competition.

BFS generated the M3 forecasts in April 1997, employing a Beta-test version of its desktop product Forecast Pro Version 3, Extended Edition. This product has since been revised and is now commercially available as Forecast Pro Version 4. All of the BFS products are based upon the dynamic link library FpwLib.Dll, an Application Program Interface (API) to the BFS forecasting engine. This program, which has no interface, can be accessed from within the code of a client program. Thus Forecast Pro Unlimited, which can handle as many as one million items at a time, creates essentially the same forecasts. Many details of the forecasting process are under direct control of the user.

In this case all forecasts were prepared entirely automatically under the *Expert Selection* option of the product. Because the M3 data set was too large for the product we used, the file was broken down and forecasted in several executions. The total time used was about 15 min on a Dell Pentium Pro 200 MHz computer, by today's standards a slow computer.

The basic premise of the Forecast Pro methodology is simple – fit the appropriate forecasting model to the data at hand. To accomplish this, Forecast Pro has three logical layers.

1. The top layer consists of a master control program to select the family of models to be selected, e.g. exponential smoothing or Box–Jenkins[1]. This protocol is executed when *Expert selection* is chosen from the menu.
2. The second layer identifies a particular model from the family, e.g. ARIMA(1,1,0) or multiplicative Winters. The identification protocol is, of course, specialized to the particular method.
3. The third layer optimizes the parameters via

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[1]We use the term Box–Jenkins even though it is technically incorrect. Forecast Pro identifies ARIMA models via a procedure altogether different from that espoused by Box and Jenkins (1976).