Revision confidence limits for recent data on trend levels, trend growth rates and seasonally adjusted levels

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Statement of problem

• The latest seasonally adjusted and trend values will be revised as new data are added…
• …even if the unadjusted data are not changed.
• Data compilers know this, but it is not usually highlighted in statistical output.
• Even the compilers seldom have a quantitative idea of the likely extent of revisions.
• There are situations where knowledge of the likely extent of future revisions will aid data users in interpreting current data.
Possible solution

• SEATS output includes estimates of revision standard error for trend and seasonally adjusted.
• X-12-ARIMA has no corresponding output…
• …so can we define a procedure to obtain one?
• If X-12-ARIMA analysis includes an ARIMA model, we can formulate the requirement as:
  – What range of revisions is consistent with the future evolution of the ARIMA model of the series?
• Look for a mathematical representation of this requirement.
Calculation Method (1)

- The default forecast of the ARIMA model assumes all innovations are zero.
- Actual realisations are generated by sampling a set of innovations from a Gaussian model.
- We could generate a large set of realisations and see the extent of revisions (Monte Carlo).
- But it would be more convenient to have a way of expressing the revisions as a function of the innovations.
Calculation Method (2)

• Use the ‘black box’ method – find the response of the filter system to an impulse innovation at each forecast time point.

• Consider how far ahead to estimate revisions – we must be confident that the ARIMA model will provide a reasonable representation.

• Chosen forecast horizon is 36 months.

• How far back to calculate revision limits? – more than 36 months back change is negligible.
Calculation Method (3)

• The first step is to carry out a full modelling and estimation run, identifying an ARIMA model and producing 36 months of forecasts (with zero innovations).
• Table B1 from this run is the basis for all the later variations with non-zero innovations.
• We need to assume that the effects of the future innovations on past values are additive.
• Experiment shows that we cannot make this assumption if extreme values are modified.
  – (This applies only to revision limit estimation)
Calculation Method (4)

- First run to calculate base series for trend and seas. adj. – apply x-11 with no modification of extremes to saved Table B1.
- Modify saved B1 by assuming an innovation of one s.e. in the first forecast period (all others remain zero).
- Apply x-11 to this modified series, again with no extremes.
- Repeat with the non-zero innovation in forecast period 2, 3, ..., 36.
Calculation Method (5)

• Calculate differences between the 36 variant results and the base case.

• These are the coefficients of the linear approximation to the relationship between the actual innovations and the revision to the base trend and s.adj. series.

• Since the innovations are by definition independent, the sum of squares of these coefficients gives the variance of the revision.
Illustration and Testing

• Use Box-Jenkins airline passengers series.
• Initial modelling with X-12-ARIMA identifies model (0 1 1)(0 1 1) and trading day effect.
• Rerun with TD gives model (1 1 0)(0 1 1) - the TD effect is weekday – weekend contrast.
• Take (1 1 0)(0 1 1) with TD as basic model for this series.
• Model (0 1 1)(0 1 1) with TD is a close second and is used as a variant.
Figure 1: Box-Jenkins Airline Data
Original, SA and Trend
Figure 4: Box-Jenkins Airline Data
Revision Limits for X-11 Alternative SA
Figure 6: Box-Jenkins Airline Data
Revision Limits for Seats Trend
Figure 7: Box-Jenkins Airline Data
Comparison of Trend Revision Limits for Seats and X-11
Figure 8: Box-Jenkins Airline Data
Comparison of Formula and Monte Carlo Trend Revision Limits
(no extreme modification)
Figure 8a: Box-Jenkins Airline Data
Comparison of Formula and Monte Carlo Trend Revision Limits
(with extreme modification)
Figure 8b: Box-Jenkins Airline Data
Comparison of Formula and Monte Carlo SA Revision Limits
(with extreme modification)
Example 2

• UK Claimant Count Unemployment.
• No longer the preferred measure – superseded by harmonised measure based on Labour Force Survey.
• But a useful indicator –
  – precise (no sampling)
  – rapidly available
  – clear turning points
Figure 9: UK Claimant Count Unemployment
Original, SA and Trend
Figure 11: UK Claimant Count Unemployment
Revision Limits for X-11 Trend (data to March 2005)
Figure 12: UK Claimant Count Unemployment
Revision Limits for X-11 Trend (data to April 2005)
Example 3

- UK Consumer Price Index
- Harmonised (standard European measure)
- Growth rate is official inflation target for Bank of England Monetary Policy Committee.
- No official seasonal adjustment
- Growth rate is 12-month change in unadjusted index level.
Figure 13: UK Consumer Price Index
Original, SA and Trend
Figure 16: UK Consumer Price Index
Revision Limits for X-11 Trend Growth Rate (H23)
Outstanding Questions

• We are looking at revisions in the X-11 process; what about revisions to regARIMA (level shifts, trading day factors, etc.)?
• If the published s.adj. is based on 12 months’ forecasts, should we still use 36 to estimate the revision limits?
• If there are serious doubts about the additivity of the individual innovation effects, should we use the Monte Carlo approach?
• How best to present the results graphically?
Summary and Conclusions

• The examples show that the inclusion of revision limits can give useful information to data users.

• SEATS can already provide limits; the method proposed here enables X-12-ARIMA to do the same.

• The method does not involve long computation; even if we use the Monte Carlo approach it is just a matter of minutes.

• More research is needed!