SEASABS: Australian Bureau of Statistics seasonal adjustment package

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SEASABS
Australian Bureau of Statistics
seasonal adjustment package

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SEASABS
What is it?

- SEASABS: The Australian Bureau of Statistics seasonal adjustment package
  - SEASONal analysis ABS standard
  - based on an ABS enhanced version of X11
  - uses a knowledge based intelligent system to interpret X11 outputs and modify parameters and prior corrections
  - continual improvement
  - links to X12-ARIMA and uses regression-ARIMA and ARIMA methods
SEASABS
Enhancements

- ABS enhancements
  - Moving trading day
  - Easter proximity tailored for Australia
  - Father's Day proximity
  - X12ARIMA link to SEASABS to use regression ARIMA output
  - use of ARIMA models
  - continual improvement to existing functions, graphics and usability
  - X11.dll linked to Splus and R for research
SEASABS suite
Modular design: SEASABS

- An analysis module (SEASABS)
  - used by the "experts"
  - creates seasonal factors for directly adjusted time series

- An update module (TSupdate)
  - used by "experts" and "non-experts" to create seasonally adjusted and trend estimates for both direct and indirect time series

- Time Series Toolkit
  - for "non-experts" as an interface to view results
SEASABS suite

Broad detail: how does it all work together?

- SEASABS Seasonal adjustment
- Time series Update run periodically
- Taking original data from ABSDB
- Save analysis knowledge
- Derive seasonally adjusted and trend estimates
- Original Adjusted Trend
- Statistical Data
- Metadata
- ABSDB
- Series Knowledge
- Toolkit
- www.abs.gov.au
SEASABS
Basic iterations

1. Check revisions to original estimates
2. Apply existing prior factors from series knowledge
   May include ARIMA models
3. Run X11.dll. All detection algorithms are X11 based
4. Identify and correct for seasonal breaks
5. Identify and modify large residuals (irregular) as trend break algorithm behaves better without them
6. Identify and modify large residuals

Moving holiday corrections checked, e.g. large extremes in March or April of an Easter year may in fact be corrected inserting Easter factors - don't modify. Check for run of extremes in the same month in preceding years (may be trend break)

7. Apply trend break algorithm

- full span for first time looking at a series
- only last 10 years at a reanalysis
SEASABS
Basic iterations (continued)

8. Identify and modify residual/irregulars greater than 6 sigma. For quarterly 9 sigma. Check again for extremes that may coincide with moving holidays or trend breaks

9. Checks and Modification: static trading day, trend moving average, seasonal moving average, Easter proximity, Australia Day, Chinese New Year, Fathers day proximity, patterns in the irregular, ...

10. Finalise seasonal adjustment and output final seasonal factors
Each month or quarter Time Series Update automatically does the following:

- extends seasonally adjusted data and trend estimates by one observation
  - Uses options set within the system for individual time series, eg. Concurrent seasonal adjustment or apply set ARIMA models
- does sensitivity analysis where upper and lower trend paths are calculated
- derives higher order aggregates
Aggregation structures
Simple

AUSTOTAL = UC94SI901011
+ UC94SI902021
+ UC94SI903031
+ UC94SI904031
+ UC94SI905042
+ UC94SI906053
+ UC94SI907063
+ UC94SI908074
+ UC94SI909084
+ UC94SI910094
+ UC94SI911105
+ UC94SI912115
+ UC94SI913115
+ UC94SI914126
+ UC94SI915136
+ UC94SI916136
+ UC94SI917147
+ UC94SI918157
+ UC94SI919167
Aggregation structures
Complicated structure

- Different functions: +, *, /, splice, lag, ...
- Numerous levels
SEASABS

Setting data up within SEASABS

- SEASABS works by grouping data together
1. Need to ensure you have the appropriate options for trading day, ARIMA, ...

2. Choose appropriate series and click ok.

3. Need to ensure you have the appropriate options for trading day, ARIMA, ...

4. Additional series options.
Research will run the SEASABS knowledge base and help you determine effects in the series.

Concurrent adjustment will run with no knowledge rules and will use the existing prior corrections.

Concurrent X11 will ignore forecasting options if they exist.

X12ARIMA interface allows the user to run X12ARIMA.
SEASABS puts in the appropriate parameters from the series knowledge for you.

Can use this to do standalone X12ARIMA runs
Metadata
Series properties

- Can store an extract information like
  - Readable name (eg. Australian Total Retail)
  - Dataname (eg. UCPG98)
  - Analysis span used to analyse the data
  - Update date
  - Periodicity of the time series
  - Type of decomposition
  - Aggregation structures: Is this series an indirect or direct time series and what is its relationships to other time series
  - ...

Metadata
Analysis information

- Stores and extracts information like
  - Trend Moving Average
  - Seasonal Moving Average
  - Trading day
  - Large extreme corrections
  - Trend Break corrections
  - Seasonal Break corrections
  - Moving Holiday corrections
  - Concurrent or forward factor or ARIMA
  - ARIMA model order parameter estimates
  - ...
Metadata
Previous information (benchmark)

- Can store information like
  - Relevant diagnostics and series from the last Analysis
  - For example
    - seasonal factors from the last analysis for comparison
    - ARIMA models and parameters
    - ...
SEASABS
Demonstration
Improving SEASABS
Increase in ARIMA capabilities

- Strengthen link to X12ARIMA
  - Ability to choose to use and apply the large extreme or level shift regressions automatically available within X12ARIMA.

- Automation of the application of regression-ARIMA and ARIMA models to reduce dependency on individual users

- Systematic storage and retrieval of custom and standard regressors with the associated metadata
Published official government statistics are typically derived in a univariate approach with limited knowledge of related time series from different areas.

Need to manage and measure the consistency of related time series:
- For example, consistency of seasonal adjustment options between state totals and a national total.

Recently trialed within ABS.
Once the relationship between different time series is known then consistency measures can be calculated and assessed

- For example, the seasonal adjustment decomposition, application and magnitude of prior factor corrections, significant differences and cross correlations in percentage movements
### Consistency Summary

<table>
<thead>
<tr>
<th>Series match: 1</th>
<th>(1) SEASABS_BOPM_0.A2_100_GOODS</th>
<th>(2) SEASABS_QGOODSCR_S.A2_100_GOODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Spans</td>
<td>07 1971 --&gt; 11 2005</td>
<td>09 1959 --&gt; 09 2005</td>
</tr>
<tr>
<td>Period</td>
<td>MONTHLY</td>
<td>QUARTERLY</td>
</tr>
<tr>
<td>Method</td>
<td>Indirect</td>
<td>Indirect</td>
</tr>
<tr>
<td>Model</td>
<td>Multiplicative</td>
<td>Multiplicative</td>
</tr>
<tr>
<td>TMA</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>PUE_TMA</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>PUE_EWP</td>
<td>3.50000</td>
<td>0.60000</td>
</tr>
<tr>
<td>SMA</td>
<td>3x5</td>
<td>3x5</td>
</tr>
<tr>
<td>Trend breaks</td>
<td>* 04 2005 0.94909 * 04 2004 0.95599 * 10 1996 0.98515</td>
<td>* 02 2005 0.95106 * 02 2004 0.97178 * 04 1996 0.98595 * 03 1981 1.01170 * 04 1986 0.99621 * 01 1988 1.00305</td>
</tr>
<tr>
<td>Seasonal breaks</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>
Improving SEASABS: Consistency (continued)

<table>
<thead>
<tr>
<th>Outliers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>* 04 1973 1.05102 * 04 1974 1.01720 * 01 1988 1.00870 * 01 1971 0.98264 * 01 1991 0.98406 * 01 1976 1.02220 * 03 1994 1.01137 * 02 1971 1.00805 * 02 1975 1.01636 * 03 1980 0.98397 * 01 1992 0.99359 * 03 1992 0.99784 * 04 2000 1.01670 * 01 1960 1.02400 * 04 1981 0.98285 * 01 2001 1.01396 * 02 1997 1.11331 * 03 1984 1.01225 * 04 1999 1.01900 * 04 2002 1.01038 * 01 2002 1.00500 * 02 1990 1.00717 * 03 1991 1.00660 * 03 1981 0.99554 * 01 1983 0.99150 * 03 1990 0.99867 * 04 1990 1.00177 * 02 1991 0.99906 * 03 1997 1.03108</td>
<td></td>
</tr>
</tbody>
</table>

* TEMPORAL MOVEMENT PLOTS...

* TEST 1: CONSISTENCY (SANITY) CHECK BETWEEN MAIN PARAMETERS IN ABOVE TABLE:

*** Periodicities not the same: inconsistencies are expected in...
Improving SEASABS: Consistency (continued)

**Full span**
Series 1 (Blue): Series 2 (Green)

**Short (recent) span**

% Movement

Absolute movement

(month or quarter) / year
Improving SEASABS: Consistency (continued)

Cross-correlations in Movements (outliers included)

\[ 0.742 < \text{CCF}(0) < 0.86 \]

Cross-correlations in Movements (outliers removed)

\[ 0.969 < \text{CCF}(0) < 0.984 \]
Improving SEASABS
Enhancing methodological capabilities

- Implementation of an improved approach to pro-ration for systems of time series
  - Based on the Generalised Benchmarking Approach (Statistics Canada, Cholette)

- Research into an improved approach to the assessment of seasonality in time series and assessment of residual seasonality is needed
  - Application of model based approach (unit root)
Improving SEASABS
Enhancing methodological capabilities (cont)

- Improvement in estimating trading day for quarterly time series
  - Moving trading day using regression-ARIMA

- Increase coherence for monthly and quarterly time series
  - Derivation of quarterly estimates directly from equivalent monthly estimates where available
  - Reduce workload and ensure coherence
Future directions for seasonal adjustment

- Increase transparency and visibility of the seasonal adjustment process
  - by making available the full seasonal adjustment decomposition of the time series of original estimates
- Publish specific metadata about prior corrections such as estimated magnitude and real world reasons
- Free provision of seasonal adjustment capabilities on the internet as part of a National Statistical Service
Key points

SEASABS

- Series knowledge and the knowledge base store information about each time series
  - Knowledge base guides the user through the seasonal adjustment suggesting appropriate corrections
- Excellent graphical capability
- Has graphical interface to X12ARIMA
  - options are not automated as this time
- Continual improvement and development