Tramo-Seats

Reusable components for seasonal adjustment.

Department of Statistics. R&D Unit.
Thanks to

- GL. Caporello and A. Maravall (and the Bank of Spain)
  - Documentation, support, code, ...

- R&D Unit of the Department of Statistics of the NBB.
  - F. Osaer (DBs, statistical tools, X11)
  - Y. Molitor (Graphical user interfaces)
  - P. Hianne (Excel Add-ins)
Plan

- Context
- Technological solution
- Contents of the library
- Statistical aspects
- Demo
- Prospects
- Conclusions
## Context: multiple uses.

<table>
<thead>
<tr>
<th>Task</th>
<th>Product</th>
<th>IT-Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outliers detection</td>
<td>Balance of payments, National Accounts, External trade, Publications</td>
<td>GUI, Excel, batch / DB2, SQL Server</td>
</tr>
<tr>
<td>Missing values estimation / forecasts</td>
<td>Balance of payments</td>
<td>GUI, batch / SQL Server</td>
</tr>
<tr>
<td>Seasonal adjustment</td>
<td>Quarterly National Accounts, Business surveys</td>
<td>GUI, Excel, batch / SQL Server, Access</td>
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<tr>
<td>Temporal disaggregation</td>
<td>Quarterly National Accounts, Balance of payments</td>
<td>GUI, Excel, batch / SQL Server</td>
</tr>
<tr>
<td>Modelling / analysis</td>
<td>All, research</td>
<td>GUI, Excel</td>
</tr>
</tbody>
</table>

**GOAL:** Developing a tool that can be customized for each case.
Technological solution

- OO-Components
  - Managing the complexity
  - Reuse and extensibility

- Standard technologies
  - .NET (Windows), [COM]
  - Java

→ NOT a closed application, but a set of modules / packages
Design

Nbb Libraries
.NET
Java

Commercial software (Excel, ...)

In-house developments (C#, VB.NET, Java, ...)

Other [commercial] components

DBs.
Contents of the library (I)

- Time series domain (specialized topics)
  - Concepts
    - ARIMA models, TS regression, UCARIMA models (TRAMO-SEATS).
    - Structural models, state space forms (Durbin/Koopman).
  - Algorithms
    - Kalman filters / smoothers (TRAMO, DK).
    - Canonical decomposition, Wiener-Kolmogorov filters (SEATS).
    - X11, ...
  - Analysis tools
    - Residuals, ...

- Math / Stats domain
  - Concepts / algorithms related to time series problems.
    - Polynomials (unit roots), linear filters
    - Matrix computation
    - Optimization
    - Statistical distributions, tests
Contents of the library (II)

- Tramo-Seats
  - Most advanced application of the time series library.
  - Completely new implementation: **NOT a translation**.
  - Results as similar as possible of the FORTRAN ones.
  - Open solution (extensions, GUI, Excel add-ins, ...)
  - Easy use (**no file-based I/O**, just a few lines of code)
  - Missing features
    - Fixed parameters (ARIMA model)
    - skipping approach for missings values, rarely used parameters
  - New features
    - New outliers (SO, ...)
    - *Kalman smoother estimation* (SEATS)
Statistical aspects (I)

- Wiener-Kolmogorov filters
  - UCARIMA models (SEATS) extended to other models (structural models, ...)

- SSF and Kalman filters / smoothers.
  - Used in:
    - TRAMO.
    - Many other applications.
  - Based on:
    - TRAMO:
      - Fast Chandrasekhar recursions.
      - GLS estimation (KF + QR decomposition), ...
    - the Durbin-Koopman approach:
      - Diffuse initialization.
      - (Disturbance) smoother, ...

Based on:
- TRAMO:
  - Fast Chandrasekhar recursions.
  - GLS estimation (KF + QR decomposition), ...
- the Durbin-Koopman approach:
  - Diffuse initialization.
  - (Disturbance) smoother, ...
## Statistical aspects (II)
### Seasonal adjustment

<table>
<thead>
<tr>
<th>Method</th>
<th>UCARIMA models</th>
<th>Structural models (various seasonal components)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalman smoother</td>
<td>Durbin/Koopman</td>
<td>Durbin/Koopman + Proietti</td>
</tr>
<tr>
<td>WK filters</td>
<td>SEATS (Burman-Wilson)</td>
<td>&quot;Extended&quot; SEATS (Burman-Wilson)</td>
</tr>
</tbody>
</table>

+ X11 (based on the description of Ladiray/Quenneville)
Excel

- User-defined functions (Tramo-Seats, X11, BSM).
- Add-In (outliers detection).

Tramo-Seats (and others). Rich graphical interface.

Just a few lines of code...
Demo (I).
User-defined functions in Excel

Black-box use, designed for:
- fast analysis
- unskilled people
Demo (II).
Excel Add-in: Color analyser

Outliers detection with TRAMO:

• Complete integration in a commercial software
• Use of the features of the hosting application
Demo (III). Tramo-Seats:
Rich graphical interface
Demo (IV)

Just a few lines of code

Steps:
- Creation of the series
- Specifications (=input file)
- Processing
- Results retrieval:
  - detailed information
  - dynamic computations

```java
// time series
TS series = new TS(TSFrequency.Monthly, 1980, 0, data);

// specifications
TSpec specifications = new TSpec();
TSpec.ModelIdentification.IsEnabled = true;
TSpec.OutliersDetection.Allow = true;
TSpec.Specification = new TSpec();

// processing
TSpecs TSpecs = new TSpecs();
if (TSpecs.Process(series, TSpec, specifications))
{
    TS se = TSpecs.FinalComponent(TCompType.TrendCycle);
    UCM ucm = TSpecs.Seats.ucm;
}
```
Prospects

- Extensions to other approaches
  - Simulations
  - Band-pass methods
  - ...

Conclusions

- Open OO-components based on standard technologies = powerful and flexible solution for complex algorithms like seasonal adjustment.
- Need for a coherent specialized statistical framework.
- Collaboration (use or extension or ?) very welcome.