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RJDemetra: an R interface to JDemetra+

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Introduction to seasonal adjustment

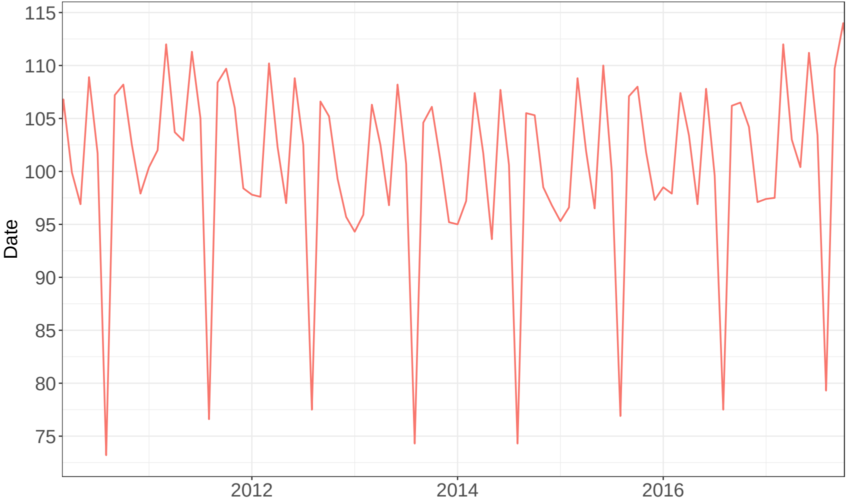

Figure 1: Industrial production index in France

Why and how perform seasonal adjustment?

Purpose of seasonal adjustment:

- Time comparison (outlook, short-term evolution...)
- Spatial comparison

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Two leading methods:

- TRAMO/SEATS+ (Bank of Spain)
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$\rightarrow$ proceed in two steps:

1. Pre-adjusting the series of deterministics effects with a RegARIMA model
2. Decomposition: to extract seasonal component

What's JDemetra+ ?

Time Series Software for Official Statistics TRAMO/SEATS+ and X-13ARIMA-SEATS are implemented in JDemetra+ (JD+)

Software officially recommended by Eurostat and the ECB for seasonal and calendar adjustment of official statistics

→ `RJDemetra` is an R interface to JDemetra+ based on the Java libraries of JD+

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Current status

- RegARIMA, TRAMO-SEATS and X-13-ARIMA:
  - pre-defined and user-defined specifications: outliers detection, ARIMA detection, userdefined regressors, transformation function...
  - S3 classes with plot, summary, print methods
- Manipulate JD+ workspaces:
  - Import JD+ workspace to get input raw series or SA model
  - Export R models created via RJDemetra
- Include a dataset: industrial production indices in manufacturing in the European Union

Object structure

A `SA` object is a `list()` of 5 elements:

```
SA
 ├─ regarima (≠ X-13 and TRAMO-SEAT)
 │   ├─ specification
 │   └─ ...
 ├─ decomposition (≠ X-13 and TRAMO-SEAT)
 │   ├─ specification
 │   └─ ...
 ├─ final
 │   ├─ series
 │   └─ forecasts
 ├─ diagnostics
 │   ├─ variance_decomposition
 │   ├─ combined_test
 │   └─ ...
 └─ user_defined
```

Create your first model

Like in JD+ users can defined their own specification or use a pre-defined one:

```
library(RJDemetra)
ipi_fr <- ipi_c_eu[, "FR"]
ts_mod <- tramoseats(ipi_fr, spec = "RSAfull")
x13_usr_spec <- x13_spec(spec = c("RSA5c"),
                         usrdef.outliersEnabled = TRUE,
                         usrdef.outliersType = c("LS", "AO"),
                         usrdef.outliersDate = c("2008-10-01",
                                                 "2002-01-01"),
                         usrdef.outliersCoef = c(36, 14),
                         transform.function = "None")
x13_mod <- x13(ipi_fr, x13_usr_spec, userdefined = "diagnostics.ic-ratio")
```

Use `user_defined_variables()` to get the names of the user-defined variables

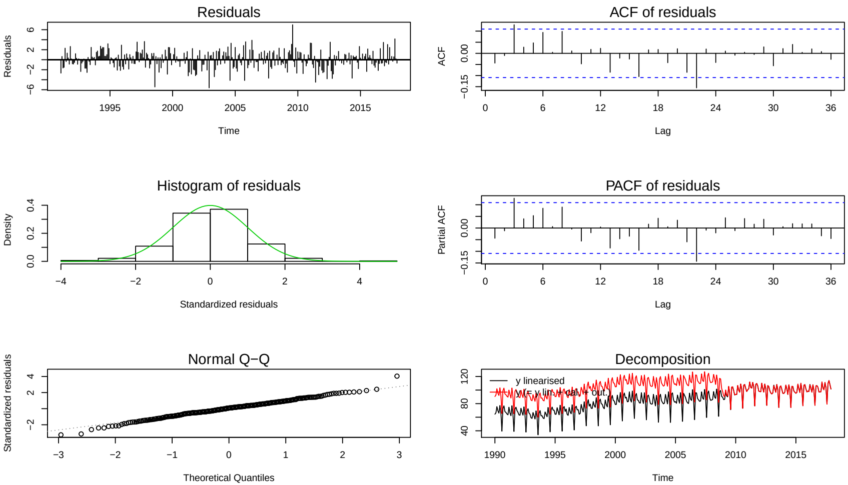
RegARIMA examples (1/2)

```
summary(x13_mod$regarima)
```

```
## y = regression model + arima (0, 1, 1, 0, 1, 1)
##
## Model: RegARIMA - X13
## Estimation span: from 1-1990 to 12-2017
## Log-transformation: no
## Regression model: no mean, no trading days effect, no leap year effect, Easte
##
## Coefficients:
## ARIMA:
##           Estimate Std. Error T-stat Pr(>|t|)
## Theta(1)  -0.53675    0.04770 -11.25   <2e-16 ***
## BTheta(1) -0.50830    0.04961 -10.25   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Regression model:
##              Estimate Std. Error  T-stat Pr(>|t|)
## Easter [1]    -1.1686     0.3385  -3.452 0.000629 ***
## AO (9-2008)   31.4099     2.1812  14.400  < 2e-16 ***
## LS (9-2008)  -56.6477     2.2561 -25.109  < 2e-16 ***
## TC (9-2008)   24.1814     3.2563   7.426 1.00e-12 ***
## LS (2-2002)   14.7081     1.5257   9.640  < 2e-16 ***
## LS (12-2001) -14.6482     1.6811  -8.714  < 2e-16 ***
```

RegARIMA examples (2/2)

```
layout(matrix(1:6, 3, 2));plot(x13_mod$regarima, ask = FALSE)
```



Seasonal adjustment examples (1/7): decomposition

```
x13_mod$decomposition
```

```
##  Monitoring and Quality Assessment Statistics:
##       M stats
## M(1)    0.055
## M(2)    0.041
## M(3)    0.926
## M(4)    0.621
## M(5)    0.724
## M(6)    0.215
## M(7)    0.074
## M(8)    0.208
## M(9)    0.056
## M(10)   0.158
## M(11)   0.146
## Q       0.297
## Q-M2    0.329
##
## Final filters:
## Seasonal filter:  3x5
## Trend filter:  13-Henderson
```

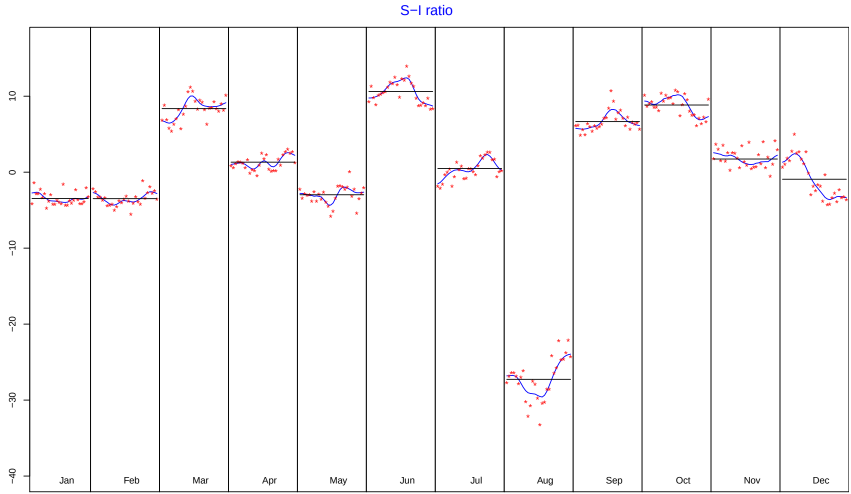
Seasonal adjustment examples (2/7): decomposition

```
ts_mod$decomposition
```

```
## Model
## AR :  1 + 0.352498 B + 0.133616 B^2
## D :  1 - B - B^12 + B^13
## MA :  1 - 0.186819 B - 0.610856 B^12 + 0.114119 B^13
##
##
## SA
## D :  1 - 2.000000 B + B^2
## MA :  1 - 1.314459 B + 0.340427 B^2
## Innovation variance:  0.4669153
##
## Trend
## D :  1 - 2.000000 B + B^2
## MA :  1 + 0.040206 B - 0.959794 B^2
## Innovation variance:  0.04869563
##
## Seasonal
## AR :  1 + 0.352498 B + 0.133616 B^2
## D :  1 + B + B^2 + B^3 + B^4 + B^5 + B^6 + B^7 + B^8 + B^9 + B^10 + B^11
## MA :  1 + 0.717848 B + 0.460721 B^2 + 0.310085 B^3 + 0.132447 B^4 - 0.049053
## Innovation variance:  0.1601924
##
## Irregular
```

Seasonal adjustment examples (3/7)

```
plot(x13_mod$decomposition)
```



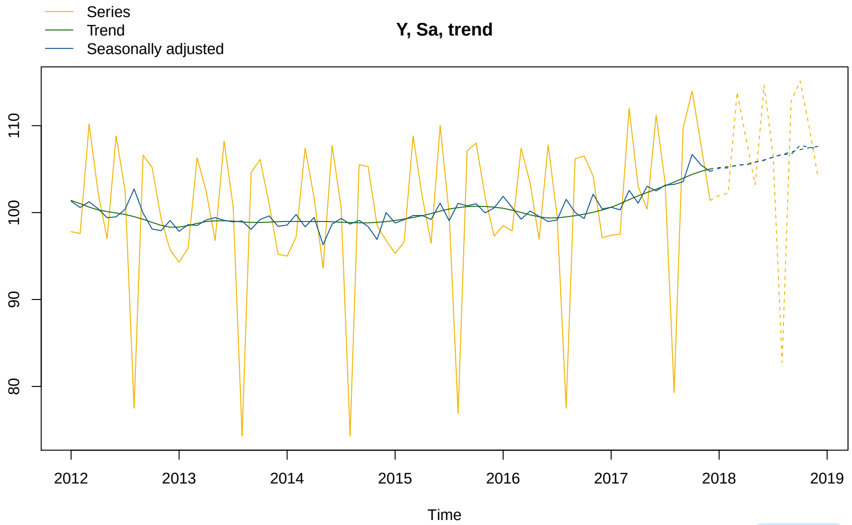
Seasonal adjustment examples (4/7)

```
x13_mod$final
```

```
## Last observed values
##                  y       sa        t           s             i
## Jan 2017  97.4 100.6172 100.6174  -3.2172329 -0.0001992082
## Feb 2017  97.5 100.3127 101.0283  -2.8126932 -0.7155966863
## Mar 2017 112.0 102.5469 101.4894   9.4530696  1.0575376567
## Apr 2017 103.0 101.0897 101.9282   1.9103111 -0.8385432983
## May 2017 100.4 103.0319 102.3136  -2.6318733  0.7182480125
## Jun 2017 111.2 102.4926 102.6921   8.7074293 -0.1994894034
## Jul 2017 103.4 103.1596 103.0816   0.2404277  0.0779236963
## Aug 2017  79.3 103.2483 103.5055 -23.9483256 -0.2572170473
## Sep 2017 109.7 103.5536 103.9555   6.1464361 -0.4019376040
## Oct 2017 114.0 106.6886 104.3955   7.3113786  2.2931579296
## Nov 2017 107.7 105.4631 104.7505   2.2369236  0.7125546908
## Dec 2017 101.4 104.7490 105.0214  -3.3490189 -0.2723590878
##
## Forecasts:
##                    y_f     sa_f      t_f         s_f          i_f
## Jan 2018 101.96630 105.0963 105.1795  -3.1299775 -0.083200162
## Feb 2018 102.23632 105.1464 105.2838  -2.9100563 -0.137428535
## Mar 2018 113.85794 105.5026 105.3966   8.3553336  0.105971540
## Apr 2018 108.47477 105.4896 105.5573   2.9851827 -0.067754048
## May 2018 103.22164 105.7963 105.7844  -2.5746309  0.011859024
## Jun 2018 114.64042 106.0073 106.0629   8.6331483 -0.055612674
```

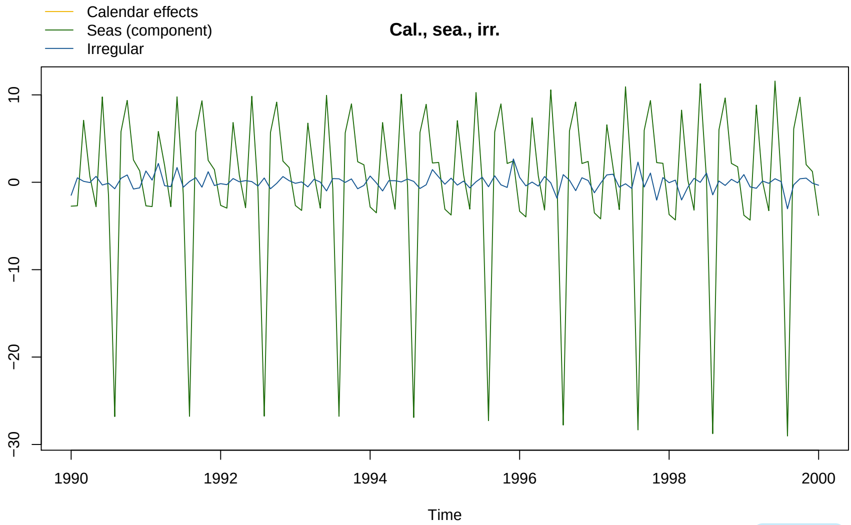
Seasonal adjustment examples (5/7)

```
plot(x13_mod$final, first_date = 2012, type_chart = "sa-trend")
```



Seasonal adjustment examples (6/7)

```
plot(x13_mod$final, last_date = 2000, type_chart = "cal-seas-irr"
```



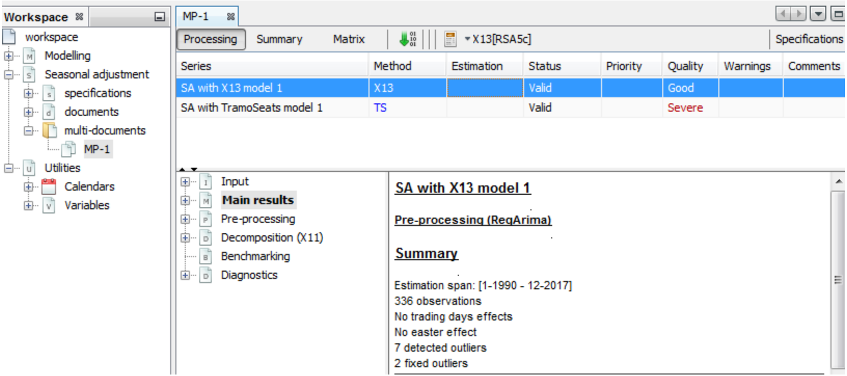
Seasonal adjustment examples (7/7)

```
x13_mod$diagnostics
```

```
##  Relative contribution of the components to the stationary
##  portion of the variance in the original series,
##  after the removal of the long term trend
##  Trend computed by Hodrick-Prescott filter (cycle length = 8.0 years)
##           Component
##  Cycle         1.557
##  Seasonal     39.219
##  Irregular     0.362
##  TD & Hol.     0.018
##  Others       61.971
##  Total       103.128
##
##  Combined test in the entire series
##  Non parametric tests for stable seasonality
##                                                          P.value
##    Kruskall-Wallis test                                     0.000
##    Test for the presence of seasonality assuming stability  0.000
##    Evolutive seasonality test                               0.032
##
##  Identifiable seasonality present
##
##  Residual seasonality tests
##                                       P.value
```

Export a workspace

```
wk <- new_workspace()
new_multiprocessing(wk, name = "MP-1")
add_sa_item(wk, multiprocessing = "MP-1",
            sa_obj = x13_mod, name =  "SA with X13 model 1 ")
add_sa_item(wk, multiprocessing =  "MP-1",
            sa_obj = ts_mod, name = "SA with TramoSeats model 1")
save_workspace(wk, "workspace.xml")
```



Import a workspace

```
wk <- load_workspace("workspace.xml")
compute(wk) # Important to get the Sa model
models <- get_model(wk, progress_bar = FALSE) # get all models
# Or to get one specific model:
mp <- get_object(wk, 1)
count(mp)
```

```
## [1] 2
```

```
sa2 <- get_object(mp, 2)
get_name(sa2)
```

```
## [1] "SA with TramoSeats model 1"
```

```
mod <- get_model(sa2, wk)
```

Manipulate ☕ objects (1/2)

Default functions can be time consuming (computation of outputs)... Especially if you only need one specific parameter

→ "Manipulate" java models: `jx13`, `jtramoseats`, `jregarima`, `jregarima_x13`, `jregarima_tramoseats` and `get_jmodel`

Manipulate ☕ objects (1/2)

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→ "Manipulate" java models: `jx13`, `jtramoseats`, `jregarima`, `jregarima_x13`, `jregarima_tramoseats` and `get_jmodel`

```
jx13_mod <- jx13(ipi_fr, x13_usr_spec)
# To get the available outputs:
tail(get_dictionary(jx13_mod), 2)
```

```
## [1] "diagnostics.msr-global" "diagnostics.msr(*)"
```

```
# To get an indicator:
get_indicators(jx13_mod, "diagnostics.ic-ratio")
```

```
## $`diagnostics.ic-ratio`
## [1] 4.356533
```

```
# To get the previous R output
x13_mod <- jSA2R(jx13_mod)
```

→ The output can be customize by every user/institute

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Examples of current use of RJDemetra

- `ggdemetra`: ggplot2 extension for 'RJDemetra'

https://github.com/AQLT/rjdqa

- `rjdqa`: package to help quality assessment (dashboard and quality report matrix)

https://github.com/AQLT/rjdqa

- `persephone`: enable easy processing during production of SA series (interactive plots, dashboards...)

https://github.com/statistikat/persephone

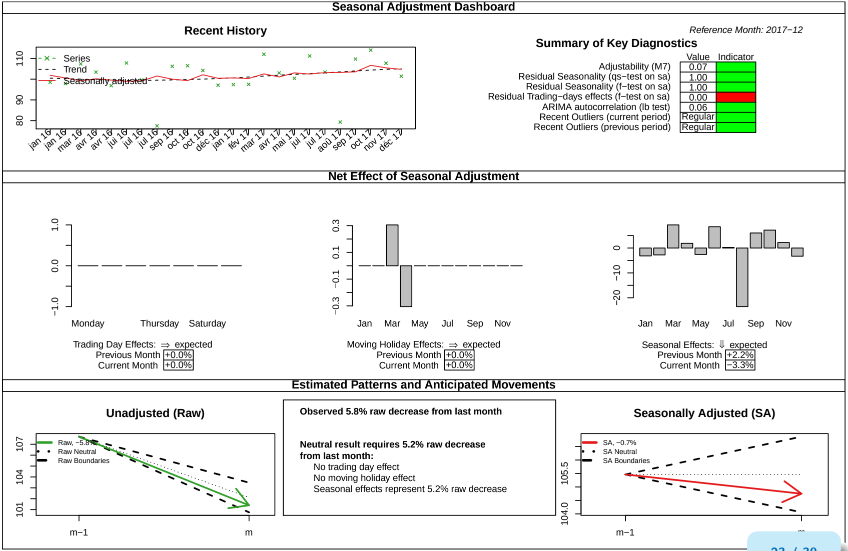
- `rjdmarkdown`: nice rmarkdown outputs for RJDemetra

https://github.com/AQLT/rjdmarkdown

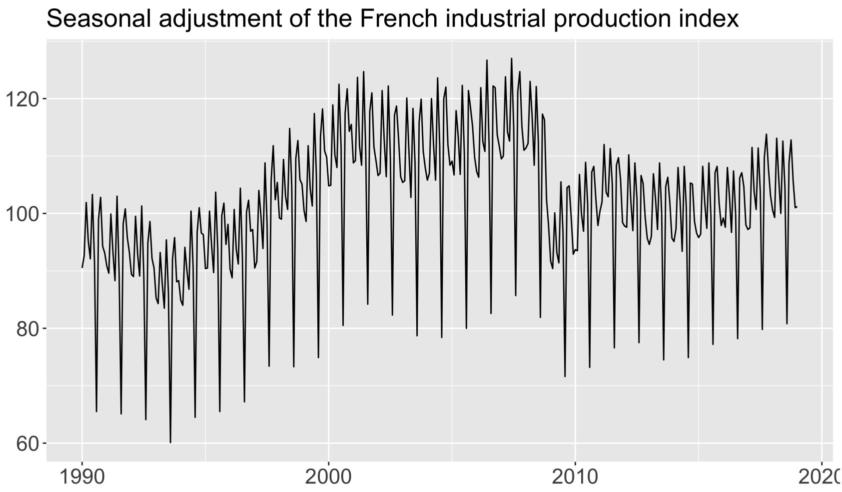
- Carry out studies on SA: Ladiray D., Quartier-la-Tente A., "(In)Stability of Reg-ARIMA Models for Seasonal Adjustment"

rjdqa

```
plot(rjdqa::sa_dashboard(x13_mod))
```



ggdemetra


Seasonal adjustment of the French industrial production index
120
100
80
60
1990
2000
2010
2020

Around JDemetra+

- State space framework of JD+:
  https://github.com/nbbrd/rjdssf
- Benchmarking and temporal disaggregation:
  https://github.com/palatej/rjdbench
- R interface to the JWSACruncher (console tool to refresh the models of a JD+ workspace):
  https://github.com/AQLT/rjwsacruncher

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How to install the package?

The package is available on : https://github.com/jdemetra/rjdemetra

```
# Cran release
install.packages("RJDemetra")

# Development version
devtools::install_github("jdemetra/rjdemetra")
```

To install it you need Java8: in case you don't, see the installation manual
https://github.com/jdemetra/rjdemetra/wiki/Installation-manual

Why use RJDemetra ?

- Methods used are recommended by Eurostat
- Performance and integration in production with JDemetra+
- Lots of R developments around `RJDemetra`
- `RJDemetra` evolves with JDemetra+: will integrate new developments on SA methods

What's next?

- documentation: article for the Journal of Statistical Software + cheat sheet
- shiny app to change the specification

With JD+ 3.0.0 (by the end of 2020):

- Function to "refresh" the model
- Compatibility with all frequencies (JD+ daily, weekly, etc.)

Thank you for your attention

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jdemetra/rjdemetra
@JdemetraPlus