Package ‘RJDemetra’

March 23, 2022

Type Package

Title Interface to 'JDemetra+' Seasonal Adjustment Software

Version 0.2.0

Description Interface around 'JDemetra+' (<https://github.com/jdemetra/jdemetra-app>), the seasonal adjustment software officially recommended to the members of the European Statistical System (ESS) and the European System of Central Banks. It offers full access to all options and outputs of 'JDemetra+', including the two leading seasonal adjustment methods TRAMO/SEATS+ and X-12ARIMA/X-13ARIMA-SEATS.

Depends R (>= 3.1.1),
Imports rJava (>= 0.9-8), graphics, grDevices, methods, stats, utils
SystemRequirements Java JRE 8 or higher.
License EUPL

URL https://github.com/jdemetra/rjdemetra

LazyData TRUE

Suggests knitr, rmarkdown

RoxygenNote 7.1.2

BugReports https://github.com/jdemetra/rjdemetra/issues

Encoding UTF-8

NeedsCompilation no

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Repository CRAN

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add_sa_item

Add a seasonally adjusted series to a multi-processing

Description
Function to add a new seasonally adjusted object (class "SA" or "jSA") to a workspace object.

Usage
add_sa_item(workspace, multiprocessing, sa_obj, name)

Arguments
- workspace: the workspace to add the seasonally adjusted series to.
- multiprocessing: the name or index of the multiprocessing to add the seasonally adjusted series to.
- sa_obj: the seasonally adjusted object to add
- name: the name of the seasonally adjusted series in the multiprocessing. By default the name of the sa_obj is used.
compute

See Also
load_workspace, save_workspace

Examples

dir <- tempdir()
# Adjustment of a series with the x13 and Tramo-Seats methods
spec_x13 <- x13_spec(spec = "RSA5c", easter.enabled = FALSE)
sa_x13 <- x13(ipi_c_eu[, "FR"], spec = spec_x13)
spec_ts <- tramoseats_spec(spec = "RSA5")
sa_ts <- jtramoseats(ipi_c_eu[, "FR"], spec = spec_ts)

# Creation of a new workspace..
wk <- new_workspace()
# and of the multiprocessing "sa1" that will contain the series
new_multiprocessing(wk, "sa1")
# Addition of the adjusted series to the workspace via the sa1 multiprocessing
add_sa_item(wk, "sa1", sa_x13, "X13")
add_sa_item(wk, "sa1", sa_ts, "TramoSeats")

# Export of the new filled workspace
save_workspace(wk, file.path(dir, "workspace.xml"))

compute

Compute a workspace multi-processing(s)

Description
Function to compute all the multi-processings or only a given one from a workspace. By default, the workspace only contains definitions: computation is needed to recalculate and access the adjusted model (with get_model).

Usage
compute(workspace, i)

Arguments
workspace the workspace to compute.
i a character or numeric indicating the name or the index of the multiprocessing to compute. By default, all multi-processings are computed.

See Also
get_model
count

Examples

```r
spec_x13 <- x13_spec(spec = "RSA5c", easter.enabled = FALSE)
sa_x13 <- x13(ipi_c_eu[, "FR"], spec = spec_x13)

wk <- new_workspace()
mp <- new_multiprocessing(wk, "sa1")
add_sa_item(wk, "sa1", sa_x13, "X13")

sa_item1 <- get_object(mp, 1)

get_model(sa_item1, wk) # Returns NULL

compute(wk)

get_model(sa_item1, wk) # Returns the SA model sa_x13
```

count

Count the number of objects inside a workspace or multiprocessing

Description

Generic functions to count the number of multiprocessing (respectively sa_item) inside a workspace (respectively multiprocessing).

Usage

```r
count(x)
```

Arguments

- `x` the workspace or the multiprocessing.

See Also

Other functions to retrieve information from a workspace, multiprocessing or sa_item: `get_model`, `get_name`, `get_ts`.

Examples

```r
wk <- new_workspace()
mp <- new_multiprocessing(wk, "sa1")
count(wk) # 1 multiprocessing inside the workspace wk
count(mp) # 0 sa_item inside the multiprocessing mp
```
get_model  

Get the seasonally adjusted model from a workspace

Description

Generic functions to retrieve seasonally adjusted model(s) from workspace, multiprocessing or sa_item object. get_model returns a "SA" object while get_jmodel returns the Java objects of the models.

Usage

get_jmodel(x, workspace, userdefined = NULL, progress_bar = TRUE)

get_model(x, workspace, userdefined = NULL, progress_bar = TRUE)

Arguments

x the object from which to retrieve the seasonally adjusted model.
workspace the workspace object where models are stored. If x is a workspace object, this parameter is not used.
userdefined a vector containing the names of additional output variables. (see x13 or tramoseats).
progress_bar boolean: if TRUE, a progress bar is printed.

Value

get_model() returns a seasonally adjusted object (class c("SA","X13") or c("SA","TRAMO_SEATS")) or a list of seasonally adjusted objects:

- if x is a sa_item object, get_model(x) returns a "SA" object (or a jSA object with get_jmodel(x));
- if x is a multiprocessing object, get_ts(x) returns a list of length the number of sa_items, each element containing a "SA" object (or a jSA object with get_jmodel(x));
- if x is a workspace object, get_ts(x) returns list of length the number of multiprocessings, each element containing a list of "SA" object(s) (or jSA object's) with get_jmodel(x)).

See Also

Other functions to retrieve information from a workspace, multiprocessing or sa_item: count, get_name, get_ts.

compute
Examples

```r
spec_x13 <- x13_spec(spec = "RSA5c", easter.enabled = FALSE)
sa_x13 <- x13(ipi_c_eu[, "FR"], spec = spec_x13)
spec_ts <- tramoseats_spec(spec = "RSA5")
sa_ts <- tramoseats(ipi_c_eu[, "FR"], spec = spec_ts)

wk <- new_workspace()
mp <- new_multiprocessing(wk, "sa1")
add_sa_item(wk, "sa1", sa_x13, "X13")
add_sa_item(wk, "sa1", sa_ts, "TramoSeats")

compute(wk) # It's important to compute the workspace before retrieving the SA model
sa_item1 <- get_object(mp, 1)

get_model(sa_item1, wk) # To extract the model of the sa_item1: its the object sa_x13

# To get all models from the multiprocessing mp:
get_model(mp, wk)

# To get all models from the workspace wk:
get_model(wk)
```

---

**get_name**

Get the Java name of a multiprocessing or a sa_item

Description

Generic functions to retrieve the Java name of a multiprocessing or a sa_item.

Usage

```r
get_name(x)
```

Arguments

- `x` the object to retrieve the name from.

Value

A character.

See Also

Other functions to retrieve information from a workspace, multiprocessing or sa_item: count, get_model, get_ts.
get_object

Examples

```r
spec_x13 <- x13_spec(spec = "RSA5c", easter.enabled = FALSE)
sa_x13 <- x13(ipi_c_eu[, "FR"], spec = spec_x13)
spec_ts <- tramoseats_spec(spec = "RSA5")
sa_ts <- tramoseats(ipi_c_eu[, "FR"], spec = spec_ts)

wk <- new_workspace()
mp <- new_multiprocessing(wk, "sal")
add_sa_item(wk, "sal", sa_x13, "X13")
add_sa_item(wk, "sal", sa_ts, "TramoSeats")

sa_item1 <- get_object(mp, 1)
sa_item2 <- get_object(mp, 2)

get_name(sa_item1) # returns "X13"
get_name(sa_item2) # returns "TramoSeats"

get_name(mp) # returns "sal"

# To retrieve the name of every sa_item in a given multiprocessing:
sapply(get_all_objects(mp), get_name)

# To retrieve the name of every multiprocessing in a given workspace:
sapply(get_all_objects(wk), get_name)

# To retrieve the name of every sa_item in a given workspace:
lapply(get_all_objects(wk), function(mp){
  sapply(get_all_objects(mp), get_name)
})
```

---

**get_object**  
*Get objects inside a workspace or multiprocessing*

**Description**

Generic functions to retrieve all (`get_all_objects()`) multiprocessing (respectively `sa_item`) from a workspace (respectively multiprocessing) or to retrieve a single one (`get_object()`).

**Usage**

```r
get_object(x, pos = 1)

get_all_objects(x)
```

**Arguments**

- `x`  
  the object to store the extracted multiprocessing or `sa_item`.

- `pos`  
  the index of the object to extract.
get_ts

Value

An object of class multiprocessing or sa_item (for get_object()) or a list of objects of class multiprocessing or sa_item (for get_all_objects()).

See Also

Other functions to retrieve informations from a workspace, multiprocessing or sa_item: count, get_model, get_name, get_ts.

Examples

sa_x13 <- x13(ipi_c_eu[, "FR"], spec = "RSA5c")
wk <- new_workspace()
mp <- new_multiprocessing(wk, "sa1")
add_sa_item(wk, "sa1", sa_x13, "X13")

# A way to retrieve the multiprocessing:
mp <- get_object(wk, 1)
# And the sa_item object:
sa_item <- get_object(mp, 1)

get_ts

Get the input raw time series

Description

Generic functions to retrieve the input raw time series of a workspace, multiprocessing, sa_item or SA object.

Usage

get_ts(x)

Arguments

x the object from which to retrieve the time series.

Value

get_ts() returns a ts object or list of ts objects:

• if x is a sa_item or a SA object, get_ts(x) returns a single ts object;
• if x is a multiprocessing object, get_ts(x) returns a list of length the number of sa_items, each element being a ts object;
• if x is a workspace object, get_ts(x) returns a list of length the number of multiprocessings, each element being a list of ts objects.
ipi_c_eu

See Also

Other functions to retrieve information from a workspace, multiprocessing or sa_item: count, get_model, get_name.

Examples

```r
sa_x13 <- x13(ipi_c_eu[, "FR"], spec = "RSA5c")
wk <- new_workspace()
mp <- new_multiprocessing(wk, "sa1")
add_sa_item(wk, "sa1", sa_x13, "X13")
sa_item <- get_object(mp, 1)

# Extracting the raw time series from an adjusted series:
get_ts(sa_x13) # Returns the ts object ipi_c_eu[, "FR"]

# Extracting the raw time series from a sa_item:
get_ts(sa_item) # Returns the ts object ipi_c_eu[, "FR"]

# Extracting all raw time series from a multiprocessing:
# Returns a list of length 1 named "X13" containing the ts object ipi_c_eu[, "FR"]:
get_ts(mp)

# Extracting all raw time series from a workspace:
# Returns a list of length 1 named "sa1" containing a list
# of length 1 named "X13", containing the ts object ipi_c_eu[, "FR"]
get_ts(wk)
```

Description

A dataset containing on monthly industrial production indices in manufacturing in the European Union (from sts_inpr_m dataset of Eurostat). Data are based 100 in 2015 and are unadjusted, i.e. neither seasonally adjusted nor calendar adjusted.

Usage

```r
ipi_c_eu
```

Format

A monthly ts object from january 1990 to december 2020 with 34 variables.
Details

The dataset contains 34 time series corresponding to the following geographical area
BE  Belgium
BG  Bulgaria
CZ  Czechia
DK  Denmark
DE  Germany (until 1990 former territory of the FRG)
EE  Estonia
IE  Ireland
EL  Greece
ES  Spain
FR  France
HR  Croatia
IT  Italy
CY  Cyprus
LV  Latvia
LT  Lithuania
LU  Luxembourg
HU  Hungary
MT  Malta
NL  Netherlands
AT  Austria
PL  Poland
PT  Portugal
RO  Romania
SI  Slovenia
SK  Slovakia
FI  Finland
SE  Sweden
UK  United Kingdom
NO  Norway
CH  Switzerland
ME  Montenegro
MK  Former Yugoslav Republic of Macedonia, the
RS  Serbia
TR  Turkey
BA  Bosnia and Herzegovina

Source


Description

get_dictionary returns the indicators that can be extracted from "jSA" objects, get_indicators extracts a list of indicators jSA2R returns the corresponding "SA".

jSA

Functions around 'jSA' objects
Usage

get_jspec(x, ...)
get_dictionary(x)
get_indicators(x, ...)
jSA2R(x, userdefined = NULL)

Arguments

x a "jSA" object.
... characters containing the names of the indicators to extract.
userdefined a userdefined vector containing the names of additional output variables (see
user_defined_variables). Only used for "SA" objects.

Details

A "jSA" object is a list of three elements:

- "result": the Java object containing the results of a seasonal adjustment or a pre-adjustment
  method.
- "spec": the Java object containing the specification of a seasonal adjustment or a pre-adjustment
  method.
- "dictionary": the Java object containing the dictionary of a seasonal adjustment or a pre-
  adjustment method. In particular, it contains all the user-defined regressors.

get_dictionary returns the list of indicators that can be extracted from a jSA object by the function
get_indicators.
jSA2R returns the corresponding formatted seasonally adjusted ("SA" object) or RegARIMA ("regarima"
object) model.
get_jspec returns the Java object that contains the specification of an object. Such object can be
of type "jSA", "X13", "TRAMO_SEATS" or "sa_item".

Value

get_dictionary returns a vector of characters, get_indicators returns a list containing the in-
dicators that are extracted, jSA2R returns a "SA" or a "regarima" object and get_jspec returns a
Java object.

Examples

myseries <- ipi_c_eu[, "FR"]
mysa <- jx13(myseries, spec = "RSA5c")
get_dictionary(mysa)
get_indicators(mysa, "decomposition.b2", "decomposition.d10")
# To convert the Java object to an R object
ejSA2R(mysa)

load_workspace

## Description
Function to load a 'JDemetra+' workspace.

## Usage
load_workspace(file)

## Arguments
- **file**
  
  the path to the 'JDemetra+' workspace to load. By default a dialog box opens.

## Value
An object of class "workspace".

## See Also
save_workspace, get_model

---

new_workspace

## Description
Functions to create a 'JDemetra+' workspace (new_workspace()) and to add a new multi-processing (new_multiprocessing()).

## Usage
- **new_workspace()**
- **new_multiprocessing(workspace, name)**

## Arguments
- **workspace**
  
  a workspace object
- **name**
  
  character name of the new multiprocessing
Value

new_workspace() returns an object of class workspace and new_multiprocessing() returns an object of class multiprocessing.

See Also

load_workspace, save_workspace, add_sa_item

Examples

# To create and export an empty 'JDemetra+' workspace
wk <- new_workspace()
mp <- new_multiprocessing(wk, "sa1")

plot

Plotting regarima, decomposition or final results of a SA

Description

Plotting methods for the S3 class objects around the seasonal adjustment: "regarima" for RegARIMA,"decomposition_X11" and "decomposition_SEATS" for the decomposition with X13 and TRAMO-SEATS, "final" for the final SA results and "SA" for the entire seasonal adjustment object. The function plot.SA just calls the function plot.final.

Usage

## S3 method for class 'regarima'
plot(x,
     which = 1:6,
     caption = list("Residuals", "Histogram of residuals", "Normal Q-Q",
                    "ACF of residuals", "PACF of residuals", "Decomposition",
                    list("Y linearised", "Calendar effects", "Outliers effects"))[sort(which)],
     ask = prod(par("mfcol")) < length(which) && dev.interactive(),
     ...
)

## S3 method for class 'decomposition_X11'
plot(x, first_date, last_date, caption = "S-I ratio", ylim, ...)

## S3 method for class 'decomposition_SEATS'
plot(x, first_date, last_date, caption = "S-I ratio", ylim, ...)

## S3 method for class 'final'
plot
Arguments

x  
which  
caption  
ask  
...  
first_date  
last_date  
ylim  
forecast  
type_chart  

Examples

myseries <- ipi_c_eu[, "FR"]  
mysa <- x13(myseries, spec = c("RSA5c"))  
    # RegArima  
plot(mysa$regarima) # 6 graphics are plotted by default  
    # To plot only one graphic (here, the residuals) and change the title:  
plot(mysa$regarima, which = 1, caption = "Plot of residuals")  
plot(mysa$regarima, which = 7)  
    # Decomposition  
plot(mysa$decomposition) # To plot the S-I ratio
The `regarima` functions decompose the input time series into a linear deterministic component and a stochastic component. The deterministic part of the series can contain outliers, calendar effects and regression effects. The stochastic part is defined by a seasonal multiplicative ARIMA model, as discussed by BOX, G.E.P., and JENKINS, G.M. (1970). The `regarima` functions do the same computation but return the Java objects instead of a formatted output.

**Usage**

```r
jregarima(series, spec = NA)

jregarima_tramoseats(
  series,
  spec = c("TRfull", "TR0", "TR1", "TR2", "TR3", "TR4", "TR5")
)

jregarima_x13(series, spec = c("RG5c", "RG0", "RG1", "RG2c", "RG3", "RG4c"))

regarima(series, spec = NA)

regarima_tramoseats(
  series,
  spec = c("TRfull", "TR0", "TR1", "TR2", "TR3", "TR4", "TR5")
)

regarima_x13(series, spec = c("RG5c", "RG0", "RG1", "RG2c", "RG3", "RG4c"))
```

**Arguments**

- `series` a univariate time series
- `spec` the model specification. For the function:
  - `regarima`: an object of class `c("regarima_spec","X13")` or `c("regarima_spec","TRAMO_SEATS")`
  - See the functions `regarima_spec_x13` and `regarima_spec_tramoseats`
• \texttt{regarima.x13}: the name of a predefined X13 'JDemetra+' model specification (see Details). The default value is "RG5c".
• \texttt{regarima.tramoseats}: the name of a predefined TRAMO-SEATS 'JDemetra+' model specification (see Details). The default value is "TRfull".

**Details**

When seasonally adjusting with X13 and TRAMO-SEATS, the first step consists in pre-adjusting the original series with a RegARIMA model, where the original series is corrected for any deterministic effects and missing observations. This step is also referred to as the linearization of the original series.

The RegARIMA model (model with ARIMA errors) is specified as such:

\[ z_t = y_t \beta + x_t \]

where:

• \( z_t \) is the original series;
• \( \beta = (\beta_1, \ldots, \beta_n) \) is a vector of regression coefficients;
• \( y_t = (y_{1t}, \ldots, y_{nt}) \) are \( n \) regression variables (outliers, calendar effects, user-defined variables);
• \( x_t \) is a disturbance that follows the general ARIMA process: \( \phi(B)\delta(B)x_t = \theta(B)a_t \); where \( \phi(B), \delta(B) \) and \( \theta(B) \) are finite polynomials in \( B \) and \( a_t \) is a white noise variable with zero mean and a constant variance.

The polynomial \( \phi(B) \) is a stationary autoregressive (AR) polynomial in \( B \), which is a product of the stationary regular AR polynomial in \( B \) and the stationary seasonal polynomial in \( B^s \):

\[ \phi(B) = \phi_p(B)\Phi_{bp}(B^s) = (1 + \phi_1 B + \ldots + \phi_p B^p)(1 + \Phi_1 B^s + \ldots + \Phi_{bp} B^{bps}) \]

where:

• \( p \) is the number of regular AR terms (here and in 'JDemetra+', \( p \leq 3 \));
• \( bp \) is the number of seasonal AR terms (here and in 'JDemetra+', \( bp \leq 1 \));
• \( s \) is the number of observations per year (ie. The time series frequency).

The polynomial \( \theta(B) \) is an invertible moving average (MA) polynomial in \( B \), which is a product of the invertible regular MA polynomial in \( B \) and the invertible seasonal MA polynomial in \( B^s \):

\[ \theta(B) = \theta_q(B)\Theta_{bq}(B^s) = (1 + \theta_1 B + \ldots + \theta_q B^q)(1 + \Theta_1 B^s + \ldots + \Theta_{bq} B^{bps}) \]

where:

• \( q \) is the number of regular MA terms (here and in 'JDemetra+', \( q \leq 3 \));
• \( bq \) is the number of seasonal MA terms (here and in 'JDemetra+', \( bq \leq 1 \)).
The polynomial $\delta(B)$ is the non-stationary AR polynomial in $B$ (unit roots):

$$\delta(B) = (1 - B)^d(1 - B^s)^d_s$$

where:

- $d$ is the regular differencing order (here and in 'JDemetra+', $d \leq 1$);
- $d_s$ is the seasonal differencing order (here and in 'JDemetra+', $d_s \leq 1$).

NB. The notations used for AR and MA processes, as well as the model denoted as ARIMA $(P, D, Q)(BP, BD, BQ)$, are consistent with those in 'JDemetra+'.

The available predefined 'JDemetra+' X13 and TRAMO-SEATS model specifications are described in the tables below:

**X13:**

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Log/level detection</th>
<th>Outliers detection</th>
<th>Calendar effects</th>
<th>ARIMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RG1</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RG2c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RG3</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>automatic</td>
</tr>
<tr>
<td>RG4c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>RG5c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>7 td vars + Easter</td>
<td>automatic</td>
</tr>
</tbody>
</table>

**TRAMO-SEATS:**

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Log/level detection</th>
<th>Outliers detection</th>
<th>Calendar effects</th>
<th>ARIMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>TR1</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>TR2</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>TR3</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>automatic</td>
</tr>
<tr>
<td>TR4</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>TR5</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>7 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>TRfull</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>automatic</td>
<td>automatic</td>
</tr>
</tbody>
</table>

**Value**

The `jregarima/jregarima_x13/jregarima_tramoseats` functions return a `jSA` object that contains the result of the pre-adjustment method without any formatting. Therefore, the computation is faster than with the `regarima/regarima_x13/regarima_tramoseats` functions. The results of the seasonal adjustment can be extracted with the function `get_indicators`.

The `regarima/regarima_x13/regarima_tramoseats` functions return an object of class "regarima" and sub-class "X13" or "TRAMO_SEATS". `regarima_x13` returns an object of class c("regarima", "X13") and `regarima_tramoseats`, an object of class c("regarima", "TRAMO_SEATS"). For the function `regarima`, the sub-class of the object depends on the used method that is defined by the `spec` object class.

An object of class "regarima" is a list containing the following components:
 specification  a list with the model specification as defined by the spec argument. See also the Value of the `regarima_spec_x13` and `regarima_spec_tramoseats` functions.

 arma  a vector containing the orders of the autoregressive (AR), moving average (MA), seasonal AR and seasonal MA processes, as well as the regular and seasonal differencing orders (P,D,Q) (BP,BD,BQ).

 arima.coefficients  a matrix containing the estimated regular and seasonal AR and MA coefficients, as well as the associated standard errors and t-statistics values. The estimated coefficients can be also extracted with the function `coef` (whose output also includes the regression coefficients).

 regression.coefficients  a matrix containing the estimated regression variables (i.e.: mean, calendar effect, outliers and user-defined regressors) coefficients, as well as the associated standard errors and t-statistics values. The estimated coefficients can be also extracted with the function `coef` (whose output also includes the arima coefficients).

 loglik  a matrix containing the log-likelihood of the RegARIMA model as well as the associated model selection criteria statistics (AIC, AICC, BIC and BICC) and parameters (np = number of parameters in the likelihood, neffectiveobs = number of effective observations in the likelihood). These statistics can also be extracted with the function `logLik`.

 model  a list containing information on the model specification after its estimation (`spec_rslt`), as well as the decomposed elements of the input series (`ts matrix, effects`). The model specification includes information on the estimation method (`Model`) and time span (`T.span`), whether the original series was log transformed (`Log transformation`), and details on the regression part of the RegARIMA model, i.e. if it includes a Mean, Trading days effects (if so, it provides the number of regressors), Leap year effect, Easter effect and whether outliers were detected (`Outliers` if so, it provides the number of outliers). The decomposed elements of the input series contain the linearised series (`y_lin`) and the deterministic components i.e.: trading days effect (`tde`), Easter effect (`ee`), other moving holidays effect (`omhe`) and outliers effect (`total - out`, related to irregular - `out_i`, related to trend - `out_t`, related to seasonal - `out_s`).

 residuals  the residuals (time series). They can be also extracted with the function `residuals`.

 residuals.stat  a list containing statistics on the RegARIMA residuals. It provides the residuals standard error (`st.error`) and the results of normality, independence and linearity of the residuals (`tests` - object of class c("regarima_rtests","data.frame").

 forecast  a ts matrix containing the forecast of the original series (`fcst`) and its standard error (`fcsterr`).

References

Info on 'JDemetra+', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/

Examples

# X13 method
myseries <- ipi_c_eu[, "FR"]
myreg <- regarima_x13(myseries, spec = "RG5c")
summary(myreg)
plot(myreg)

myspec1 <- regarima_spec_x13(myreg, tradingdays.option = "WorkingDays")
myreg1 <- regarima(myseries, myspec1)

myspec2 <- regarima_spec_x13(myreg, usrdef.outliersEnabled = TRUE,
    usrdef.outliersType = c("LS", "AO"),
    usrdef.outliersDate = c("2008-10-01", "2002-01-01"),
    transform.function = "None")
myreg2 <- regarima(myseries, myspec2)

myspec3 <- regarima_spec_x13(myreg, automdl.enabled = FALSE,
    arima.p = 1, arima.q = 1,
    arima.bp = 0, arima.bq = 1,
    arima.coefEnabled = TRUE,
    arima.coef = c(-0.8, -0.6, 0),
    arima.coefType = c(rep("Fixed", 2), "Undefined"))
s_arimaCoef(myspec3)
myreg3 <- regarima(myseries, myspec3)
summary(myreg3)
plot(myreg3)

# TRAMO-SEATS method
myspec <- regarima_spec_tramoseats("TRfull")
myreg <- regarima(myseries, myspec)

myspec2 <- regarima_spec_tramoseats(myspec, tradingdays.mauto = "Unused",
    tradingdays.option = "WorkingDays",
    easter.type = "Standard",
    automdl.enabled = FALSE, arima.mu = TRUE)
myreg2 <- regarima(myseries, myspec2)

var1 <- ts(rnorm(length(myseries))*10, start = start(myseries), frequency = 12)
var2 <- ts(rnorm(length(myseries))*100, start = start(myseries), frequency = 12)
var <- ts.union(var1, var2)
myspec3 <- regarima_spec_tramoseats(myspec,
    usrdef.varEnabled = TRUE, usrdef.var = var)
s_preVar(myspec3)
myreg3 <- regarima(myseries, myspec3)
myreg3
RegARIMA model specification, pre-adjustment in TRAMO-SEATS

Description

Function to create (and/or modify) a c("regarima_spec","TRAMO_SEATS") class object with the RegARIMA model specification for the TRAMO-SEATS method. The object can be created from the name (character) of a predefined 'JDemetra+' model specification, a previous specification (c("regarima_spec","TRAMO_SEATS") object) or a TRAMO-SEATS RegARIMA model (c("regarima","TRAMO_SEATS")).

Usage

regarima_spec_tramoseats(
  spec = c("TRfull", "TR0", "TR1", "TR2", "TR3", "TR4", "TR5"),
  preliminary.check = NA,
  estimate.from = NA_character_,
  estimate.to = NA_character_,
  estimate.first = NA_integer_,
  estimate.last = NA_integer_,
  estimate.exclFirst = NA_integer_,
  estimate.exclLast = NA_integer_,
  estimate.tol = NA_integer_,
  estimate.eml = NA,
  estimate.urfinal = NA_integer_,
  transform.function = c(NA, "Auto", "None", "Log"),
  transform.fct = NA_integer_,
  usrdef.outliersEnabled = NA,
  usrdef.outliersType = NA,
  usrdef.outliersDate = NA,
  usrdef.outliersCoef = NA,
  usrdef.varEnabled = NA,
  usrdef.var = NA,
  usrdef.varType = NA,
  usrdef.varCoef = NA,
  tradingdays.mauto = c(NA, "Unused", "FTest", "WaldTest"),
  tradingdays.pftd = NA_integer_,
  tradingdays.option = c(NA, "TradingDays", "WorkingDays", "UserDefined", "None"),
  tradingdays.leapyear = NA,
  tradingdays.stocktd = NA_integer_,
  tradingdays.test = c(NA, "Separate_T", "Joint_F", "None"),
  easter.type = c(NA, "Unused", "Standard", "IncludeEaster", "IncludeEasterMonday"),
  easter.julian = NA,
  easter.duration = NA_integer_,
  easter.test = NA,
Arguments

spec the model specification. It can be the name (character) of a predefined 'JDemeta-tran' model specification (see Details), an object of class c("regarima_spec","TRAMO_SEATS") or an object of class c("regarima","TRAMO_SEATS"). The default is "TRfull".

preliminary.check a logical to check the quality of the input series and exclude highly problematic series e.g. the series with a number of identical observations and/or missing values above pre-specified threshold values.

The time span of the series to be used for the estimation of the RegArima model coefficients is controlled by the following six variables: estimate.from, estimate.to, estimate.first, estimate.last, estimate.exclFirst, estimate.exclLast.
and `estimate.exclLast`; where `estimate.from` and `estimate.to` have priority over remaining span control variables, `estimate.last` and `estimate.first` have priority over `estimate.exclFirst` and `estimate.exclLast`, and `estimate.last` has priority over `estimate.first`.

- **estimate.from**: character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). Can be combined with `estimate.to`.

- **estimate.to**: a character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with the parameter `estimate.from`.

- **estimate.first**: numeric, the number of periods considered at the beginning of the series.

- **estimate.last**: numeric, the number of periods considered at the end of the series.

- **estimate.exclFirst**: numeric, the number of periods excluded at the beginning of the series. It can be combined with the parameter `estimate.exclLast`.

- **estimate.exclLast**: numeric, the number of periods excluded at the end of the series. It can be combined with the parameter `estimate.exclFirst`.

- **estimate.tol**: numeric, the convergence tolerance. The absolute changes in the log-likelihood function are compared to this value to check for the convergence of the estimation iterations.

- **estimate.eml**: logical, the exact maximum likelihood estimation. If `TRUE`, the program performs an exact maximum likelihood estimation. If `FALSE`, the Unconditional Least Squares method is used.

- **estimate.urfinal**: numeric, the final unit root limit. The threshold value for the final unit root test for identification of differencing orders. If the magnitude of an AR root for the final model is smaller than this number, then a unit root is assumed, the order of the AR polynomial is reduced by one and the appropriate order of the differencing (non-seasonal, seasonal) is increased.

- **transform.function**: the transformation of the input series: "None" = no transformation of the series; "Log" = takes the log of the series; "Auto" = the program tests for the log-level specification.

- **transform.fct**: numeric controlling the bias in the log/level pre-test: `transform.fct > 1` favours levels, `transform.fct < 1` favours logs. Considered only when `transform.function` is set to "Auto".

  Control variables for the pre-specified outliers. Said pre-specified outliers are used in the model only when enabled (`usrdef.outliersEnabled=TRUE`) and when the outliers' type (`usrdef.outliersType`) and date (`usrdef.outliersDate`) are provided.

- **usrdef.outliersEnabled**: logical. If `TRUE`, the program uses the pre-specified outliers.

- **usrdef.outliersType**: a vector defining the outliers' type. Possible types are: ("AO") = additive, ("LS") = level shift, ("TC") = transitory change, ("SO") = seasonal outlier. E.g.: `usrdef.outliersType=c("AO","AO","LS")`. 


usrdef.outliersDate

a vector defining the outliers' date. The dates should be characters in format "YYYY-MM-DD". E.g.: `usrdef.outliersDate = c("2009-10-01","2005-02-01","2003-04-01").`

usrdef.outliersCoef

a vector providing fixed coefficients for the outliers. The coefficients can't be fixed if the parameter `transform.function` is set to "Auto" (i.e. if the series transformation needs to be pre-defined.) E.g.: `usrdef.outliersCoef = c(200,170,20).`

Control variables for the user-defined variables:

usrdef.varEnabled

logical. If TRUE, the program uses the user-defined variables.

usrdef.var

time series (`ts`) or a matrix of time series (`mts`) containing the user-defined variables.

usrdef.varType

a vector of character(s) defining the user-defined variables component type. Possible types are: "Undefined","Series","Trend","Seasonal","SeasonallyAdjusted","Irregular","Calendar". To use the user-defined calendar regressors, the type "Calendar" must be defined in conjunction with `tradingdays.option = "UserDefined"`. Otherwise, the program will automatically set `usrdef.varType = "Undefined"`.

usrdef.varCoef

a vector providing fixed coefficients for the user-defined variables. The coefficients can't be fixed if `transform.function` is set to "Auto" (i.e. if the series transformation needs to be pre-defined).

tradingdays.mauto

defines whether the calendar effects should be added to the model manually ("Unused") or automatically. During the automatic selection, the choice of the number of calendar variables can be based on the F-Test ("FTest") or the Wald Test ("WaldTest"); the model with higher F value is chosen, provided that it is higher than `tradingdays.pftd`.

tradingdays.pftd

numeric. The p-value used in the test specified by the automatic parameter (tradingdays.mauto) to assess the significance of the pre-tested calendar effects variables and whether they should be included in the RegArima model.

Control variables for the manual selection of calendar effects variables (tradingdays.mauto is set to "Unused"): 

tradingdays.option

to choose the trading days regression variables: "TradingDays" = six day-of-the-week regression variables; "WorkingDays" = one working/non-working day contrast variable; "None" = no correction for trading days and working days effects; "UserDefined" = user-defined trading days regressors (regressors must be defined by the usrdef.var argument with `usrdef.varType` set to "Calendar" and `usrdef.varEnabled = TRUE"). "None" must also be chosen for the "day-of-week effects" correction (and `tradingdays.stocktd` must be modified accordingly).

tradingdays.leapyear

logical. Specifies if the leap-year correction should be included. If TRUE, the model includes the leap-year effect.
tradingdays.stocktd
numeric indicating the day of the month when inventories and other stock are reported (to denote the last day of the month set the variable to 31). Modifications of this variable are taken into account only when tradingdays.option is set to "None".

tradingdays.test
defines the pre-tests of the trading day effects: "None" = calendar variables are used in the model without pre-testing; "Separate_T" = a t-test is applied to each trading day variable separately and the trading day variables are included in the RegArima model if at least one t-statistic is greater than 2.6 or if two t-statistics are greater than 2.0 (in absolute terms); "Joint_F" = a joint F-test of significance of all the trading day variables. The trading day effect is significant if the F statistic is greater than 0.95.

easter.type
acharacter that specifies the presence and the length of the Easter effect: "Unused" = the Easter effect is not considered; "Standard" = influences the period of \( n \) days strictly before Easter Sunday; "IncludeEaster" = influences the entire period \( (n) \) up to and including Easter Sunday; "IncludeEasterMonday" = influences the entire period \( (n) \) up to and including Easter Monday.

easter.julian
logical. If TRUE, the program uses the Julian Easter (expressed in Gregorian calendar).

easter.duration
numeric indicating the duration of the Easter effect (length in days, between 1 and 15).

easter.test
logical. If TRUE, the program performs a t-test for the significance of the Easter effect. The Easter effect is considered as significant if the modulus of t-statistic is greater than 1.96.

outlier.enabled
logical. If TRUE, the automatic detection of outliers is enabled in the defined time span.
The time span of the series to be searched for outliers is controlled by the following six variables: outlier.from, outlier.to, outlier.first, outlier.last, outlier.exclFirst and outlier.exclLast; where outlier.from and outlier.to have priority over the remaining span control variables, outlier.last and outlier.first have priority over outlier.exclFirst and outlier.exclLast, and outlier.last has priority over outlier.first.

outlier.from
acharacter in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). It can be combined with outlier.to.

outlier.to
acharacter in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with outlier.from.

outlier.first
numeric specifying the number of periods considered at the beginning of the series.

outlier.last
numeric specifying the number of periods considered at the end of the series.

outlier.exclFirst
numeric specifying the number of periods excluded at the beginning of the series. It can be combined with outlier.exclLast.
outlier.exclLast
    numeric specifying the number of periods excluded at the end of the series. It
    can be combined with outlier.exclFirst.

outlier.ao
    logical. If TRUE, the automatic detection of additive outliers is enabled (outlier.enabled
    must also be set to TRUE).

outlier.tc
    logical. If TRUE, the automatic detection of transitory changes is enabled
    (outlier.enabled must also be set to TRUE).

outlier.ls
    logical. If TRUE, the automatic detection of level shifts is enabled (outlier.enabled
    must also be set to TRUE).

outlier.so
    logical. If TRUE, the automatic detection of seasonal outliers is enabled (outlier.enabled
    must also be set to TRUE).

outlier.usedefcv
    logical. If TRUE, the critical value for the outliers’ detection procedure is auto-
    matically determined by the number of observations in the outlier detection time
    span. If FALSE, the procedure uses the entered critical value (outlier.cv).

outlier.cv
    numeric. The entered critical value for the outliers’ detection procedure. The
    modification of this variable is only taken in to account when outlier.usedefcv
    is set to FALSE.

outlier.ehl
    logical for the exact likelihood estimation method. It controls the method
    applied for a parameter estimation in the intermediate steps of the automatic de-
    tection and correction of outliers. If TRUE, an exact likelihood estimation method
    is used. When FALSE, the fast Hannan-Rissanen method is used.

outlier.tcrate
    numeric. The rate of decay for the transitory change outlier.

automdl.enabled
    logical. If TRUE, the automatic modelling of the ARIMA model is enabled. If
    FALSE, the parameters of the ARIMA model can be specified.

Control variables for the automatic modelling of the ARIMA model (automdl.enabled
    is set to TRUE):

automdl.acceptdefault
    logical. If TRUE, the default model (ARIMA(0,1,1)(0,1,1)) may be chosen in
    the first step of the automatic model identification. If the Ljung-Box Q statis-
    tics for the residuals is acceptable, the default model is accepted and no further
    attempt will be made to identify another model.

automdl.cancel
    numeric, the cancelation limit. If the difference in moduli of an AR and an
    MA roots (when estimating ARIMA(1,0,1)(1,0,1) models in the second step
    of the automatic identification of the differencing orders) is smaller than the
    cancelation limit, the two roots are assumed equal and cancel out.

automdl.ub1
    numeric, the first unit root limit. It is the threshold value for the initial unit
    root test in the automatic differencing procedure. When one of the roots in the
    estimation of the ARIMA(2,0,0)(1,0,0) plus mean model, performed in the first
    step of the automatic model identification procedure, is larger than first unit root
    limit in modulus, it is set equal to unity.

automdl.ub2
    numeric, the second unit root limit. When one of the roots in the estimation of
    the ARIMA(1,0,1)(1,0,1) plus mean model, which is performed in the second
    step of the automatic model identification procedure, is larger than second unit
root limit in modulus, it is checked if there is a common factor in the cor-
responding AR and MA polynomials of the ARMA model that can be cancelled
(see `automdl.cancel`). If there is no cancellation, the AR root is set equal to
unity (i.e. the differencing order changes).

`automdl.armalimit`
numeric, the arma limit. It is the threshold value for t-statistics of ARMA coef-
ficients and the constant term used for the final test of model parsimony. If the
highest order ARMA coefficient has a t-value smaller than this value in magni-
tude, the order of the model is reduced. If the constant term has a t-value smaller
than the ARMA limit in magnitude, it is removed from the set of regressors.

`automdl.reducecv`
numeric, ReduceCV. The percentage by which the outlier critical value will be
reduced when an identified model is found to have a Ljung-Box statistic with
an unacceptable confidence coefficient. The parameter should be between 0 and
1, and will only be active when automatic outlier identification is enabled. The
reduced critical value will be set to (1-ReduceCV)xCV, where CV is the original
critical value.

`automdl.ljungboxlimit`
numeric, the Ljung Box limit, setting the acceptance criterion for the confi-
dence intervals of the Ljung-Box Q statistic. If the LjungBox Q statistics for the
residuals of a final model is greater than Ljung Box limit, then the model is re-
jected, the outlier critical value is reduced, and model and outlier identification
(if specified) is redone with a reduced value.

`automdl.compare`
logical. If TRUE, the program compares the model identified by the automatic
procedure to the default model (ARIMA(0,1,1)(0,1,1)) and the model with the
best fit is selected. Criteria considered are residual diagnostics, the model struc-
ture and the number of outliers.

Control variables for the non-automatic modelling of the ARIMA model (`automdl.enabled`
is set to FALSE):

`arima.mu`
logical. If TRUE, the mean is considered as part of the ARIMA model.

`arima.p`
numeric. The order of the non-seasonal autoregressive (AR) polynomial.

`arima.d`
numeric. The regular differencing order.

`arima.q`
numeric. The order of the non-seasonal moving average (MA) polynomial.

`arima.bp`
numeric. The order of the seasonal autoregressive (AR) polynomial.

`arima.bd`
numeric. The seasonal differencing order.

`arima.bq`
numeric. The order of the seasonal moving average (MA) polynomial.

Control variables for the user-defined ARMA coefficients. Such coefficients
can be defined for the regular and seasonal autoregressive (AR) polynomials and
moving average (MA) polynomials. The model considers the coefficients
only if the procedure for their estimation (`arima.coefType`) is provided, and
the number of provided coefficients matches the sum of (regular and seasonal)
AR and MA orders (p, q, bp, bq).

`arima.coefEnabled`
logical. If TRUE, the program uses the user-defined ARMA coefficients.
arima.coef  
a vector providing the coefficients for the regular and seasonal AR and MA polynomials. The length of the vector must be equal to the sum of the regular and seasonal AR and MA orders. The coefficients shall be provided in the following order: regular AR \((\Phi - p)\) elements, regular MA \((\Theta - q)\) elements, seasonal AR \((B\Phi - bp)\) elements and seasonal MA \((B\Theta - bq)\) elements.

E.g.: \texttt{arima.coef=c(0.6,0.7)} with \texttt{arima.p=1,arima.q=0,arima.bp=1} and \texttt{arima.bq=0}.

arima.coefType  
a vector defining the ARMA coefficients estimation procedure. Possible procedures are: "Undefined" = no use of user-defined input (i.e. coefficients are estimated), "Fixed" = fixes the coefficients at the value provided by the user, "Initial" = the value defined by the user is used as initial condition. For orders for which the coefficients shall not be defined, the \texttt{arima.coef} can be set to \texttt{NA} or \texttt{0} or the \texttt{arima.coefType} can be set to "Undefined". E.g.: \texttt{arima.coef = c(-0.8,-0.6,NA)}, \texttt{arima.coefType = c("Fixed","Fixed","Undefined")}.

fcst.horizon  
numeric, the forecasting horizon. The length of the forecasts generated by the RegARIMA model in periods (positive values) or years (negative values). By default, the program generates two years forecasts (fcst.horizon set to -2).

Details

The available predefined 'JDemetra+' model specifications are described in the table below:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Log/level detection</th>
<th>Outliers detection</th>
<th>Calendar effects</th>
<th>ARIMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>TR1</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>TR2</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>TR3</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>automatic</td>
</tr>
<tr>
<td>TR4</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>TR5</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>7 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>TRfull</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>automatic</td>
<td>automatic</td>
</tr>
</tbody>
</table>

Value

A list of class \texttt{c("regarima_spec","TRAMO_SEATS"\)} with the following components, each referring to a different part of the RegARIMA model specification, mirroring the arguments of the function (for details, see the arguments description). Each lowest-level component (except the span, pre-specified outliers, user-defined variables and pre-specified ARMA coefficients) is structured within a data frame with columns denoting different variables of the model specification and rows referring to: first row = the base specification, as provided within the argument \texttt{spec}; second row = user modifications as specified by the remaining arguments of the function (e.g.: \texttt{arima.d}); and third row = the final model specification, values that will be used in the function \texttt{regarima}. The final specification (third row) shall include user modifications (row two) unless they were wrongly specified. The pre-specified outliers, user-defined variables and pre-specified ARMA coefficients consist of a list with the Predefined (base model specification) and Final values.

- \texttt{estimate} a data frame containing Variables referring to: \texttt{span} - time span for the model estimation, \texttt{tolerance} - argument \texttt{estimate.tol}, \texttt{exact_ml} - argument \texttt{estimate.eml}, \texttt{urfinal} - argument \texttt{estimate.urfinal}. The final values can be also accessed with the function \texttt{s_estimate}. 
• transforma data frame containing variables referring to: tfunction - argument transform.function, fct - argument transform.fct. The final values can be also accessed with the function s_transform.

• regressiona list containing information on the user-defined variables (userdef), trading.days effect and easter effect. The user-defined part includes: specification - data frame with the information if pre-specified outliers (outlier) and user-defined variables (variables) are included in the model and if fixed coefficients are used (outlier.coef and variables.coef). The final values can be also accessed with the function s_usrdef; outliers - matrixes with the outliers (Predefined and Final). The final outliers can be also accessed with the function s_preOut; and variables - list with the Predefined and Final user-defined variables (series) and its description (description) including information on the variable type and values of fixed coefficients. The final user-defined variables can be also accessed with the function s_preVar.

The trading.days data frame variables refer to: automatic - argument tradingdays.mauto, pftd - argument tradingdays.pftd, option - argument tradingdays.option, leapyear - argument tradingdays.leapyear, stocktd - argument tradingdays.stocktd, test - argument tradingdays.test. The final trading.days values can be also accessed with the function s_td. The easter data frame variables refer to: type - argument easter.type, julian - argument easter.julian, duration - argument easter.duration, test - argument easter.test. The final easter values can be also accessed with the function s_easter.

• outliersa data frame. Variables referring to: ao - argument outlier.ao, tc - argument outlier.tc, ls - argument outlier.ls, so - argument outlier.so, usedefcv - argument outlier.usedefcv, cv - argument outlier.cv, eml - argument outlier.eml, tcrate - argument outlier.tcrate. The final values can be also accessed with the function s_out.

• arimaa list containing a data frame with the ARIMA settings (specification) and matrixes giving information on the pre-specified ARMA coefficients (coefficients). The matrix Predefined refers to the pre-defined model specification and matrix Final, to the final specification. Both matrixes contain the values of the ARMA coefficients and the procedure for its estimation. In the data frame specification, the variable enabled refers to the argument automdl.enabled and all remaining variables (automdl.acceptdefault, automdl.cancel, automdl.ub1, automdl.ub2, automdl.armalimit, automdl.reducecv, automdl.ljungboxlimit, automdl.compare, arima.mu, arima.p, arima.d, arima.q, arima.bp, arima.bd, arima.bq) to the respective function arguments. The final values of the specification can be also accessed with the function s_arima, and final pre-specified ARMA coefficients with the function s_arimaCoef.

• forecasta data frame with the forecasting horizon (argument fcst.horizon). The final value can be also accessed with the function s_fcst.

• spana matrix containing the final time span for the model estimation and outliers’ detection. It contains the same information as the variable span in the data frames estimate and outliers. The matrix can be also accessed with the function s_span.

References

Info on 'JDemetra+', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/

Examples
myseries <- ipi_c_eu[, "FR"]
myspec1 <- regarima_spec_tramoseats(spec = "TRfull")
myreg1 <- regarima(myseries, spec = myspec1)

# To modify a pre-specified model specification
myspec2 <- regarima_spec_tramoseats(spec = "TRfull",
  tradingdays.mauto = "Unused",
  tradingdays.option = "WorkingDays",
  easter.type = "Standard",
  automdl.enabled = FALSE, arima.mu = TRUE)
myreg2 <- regarima(myseries, spec = myspec2)

# To modify the model specification of a "regarima" object
myspec3 <- regarima_spec_tramoseats(myreg1,
  tradingdays.mauto = "Unused",
  tradingdays.option = "WorkingDays",
  easter.type = "Standard", automdl.enabled = FALSE, arima.mu = TRUE)
myreg3 <- regarima(myseries, myspec3)

# To modify the model specification of a "regarima_spec" object
myspec4 <- regarima_spec_tramoseats(myspec1,
  tradingdays.mauto = "Unused",
  tradingdays.option = "WorkingDays",
  easter.type = "Standard", automdl.enabled = FALSE, arima.mu = TRUE)
myreg4 <- regarima(myseries, myspec4)

# Pre-specified outliers
myspec1 <- regarima_spec_tramoseats(spec = "TRfull",
  usrdef.outliersEnabled = TRUE,
  usrdef.outliersType = c("LS", "LS"),
  usrdef.outliersDate = c("2008-10-01", "2003-01-01"),
  usrdef.outliersCoef = c(10, -8), transform.function = "None")
s_preOut(myspec1)
myreg1 <- regarima(myseries, myspec1)
myreg1
s_preOut(myreg1)

# User-defined variables
var1 <- ts(rnorm(length(myseries)) * 10, start = start(myseries),
  frequency = 12)
var2 <- ts(rnorm(length(myseries)) * 100, start = start(myseries),
  frequency = 12)
var <- ts.union(var1, var2)

myspec1 <- regarima_spec_tramoseats(spec = "TRfull",
  usrdef.varEnabled = TRUE, usrdef.var = var)
s_preVar(myspec1)
myreg1 <- regarima(myseries, myspec1)

myspec2 <- regarima_spec_tramoseats(spec = "TRfull",
myreg2 <- regarima(myseries,myspec2)

# Pre-specified ARMA coefficients
myspec1 <- regarima_spec_tramoseats(spec = "TRfull",
arima.coefEnabled = TRUE, automdl.enabled = FALSE,
arima.p = 2, arima.q = 0, arima.bp = 1, arima.bq = 1,
arima.coef = c(-0.12, -0.12, -0.3, -0.99),
arima.coefType = rep("Fixed",4))

myreg1 <- regarima(myseries,myspec1)
myreg1
summary(myreg1)
s_arimaCoef(myspec1)
s_arimaCoef(myreg1)

---

**regarima_spec_x13**

**RegARIMA model specification: the pre-adjustment in X13**

### Description

Function to create (and/or modify) a `c("regarima_spec","X13")` class object with the RegARIMA model specification for the X13 method. The object can be created from a predefined 'JDemetra+' model specification (a character), a previous specification (c("regarima_spec","X13") object) or a X13 RegARIMA model (c("regarima","X13").

### Usage

```r
regarima_spec_x13(
    spec = c("RG5c", "RG0", "RG1", "RG2c", "RG3", "RG4c"),
    preliminary.check = NA,
    estimate.from = NA_character_,
    estimate.to = NA_character_,
    estimate.first = NA_integer_,
    estimate.last = NA_integer_,
    estimate.exclFirst = NA_integer_,
    estimate.exclLast = NA_integer_,
    estimate.tol = NA_integer_,
    transform.function = c(NA, "Auto", "None", "Log"),
    transform.adjust = c(NA, "None", "LeapYear", "LengthOfPeriod"),
    transform.aicdiff = NA_integer_,
    usrdef.outliersEnabled = NA,
    usrdef.outliersType = NA,
    usrdef.outliersDate = NA,
    usrdef.outliersCoef = NA,
    usrdef.varEnabled = NA,
)```
usrdef.var = NA,
usrdef.varType = NA,
usrdef.varCoef = NA,
tradingdays.option = c(NA, "TradingDays", "WorkingDays", "UserDefined", "None"),
tradingdays.autoadjust = NA,
tradingdays.leapyear = c(NA, "LeapYear", "LengthOfPeriod", "None"),
tradingdays.stocktd = NA_integer_,
tradingdays.test = c(NA, "Remove", "Add", "None"),
easter.enabled = NA,
easter.julian = NA,
easter.duration = NA_integer_,
easter.test = c(NA, "Add", "Remove", "None"),
outlier.enabled = NA,
outlier.from = NA_character_,
outlier.to = NA_character_,
outlier.first = NA_integer_,
outlier.last = NA_integer_,
outlier.exclFirst = NA_integer_,
outlier.exclLast = NA_integer_,
outlier.ao = NA,
outlier.tc = NA,
outlier.ls = NA,
outlier.so = NA,
outlier.usedefcv = NA,
outlier.cv = NA_integer_,
outlier.method = c(NA, "AddOne", "AddAll"),
outlier.tcrate = NA_integer_,
automdl.enabled = NA,
automdl.acceptdefault = NA,
automdl.cancel = NA_integer_,
automdl.ub1 = NA_integer_,
automdl.ub2 = NA_integer_,
automdl.mixed = NA,
automdl.balanced = NA,
automdl.armalimit = NA_integer_,
automdl.reducecv = NA_integer_,
automdl.ljungboxlimit = NA_integer_,
automdl.ubfinal = NA_integer_,
arima.mu = NA,
arima.p = NA_integer_,
arima.d = NA_integer_,
arima.q = NA_integer_,
arima.bp = NA_integer_,
arima.bd = NA_integer_,
arima.bq = NA_integer_,
arima.coefEnabled = NA,
arima.coef = NA,
arima.coefType = NA,


Arguments

spec the model specification. It can be the name (character) of a pre-defined 'JDemetra+' model specification (see Details), an object of class c("regarima_spec","X13") or an object of class c("regarima","X13"). The default value is "RG5c".

preliminary.check a boolean to check the quality of the input series and exclude highly problematic ones (e.g. the series with a number of identical observations and/or missing values above pre-specified threshold values).

The time span of the series to be used for the estimation of the RegARIMA model coefficients is controlled by the following six variables: estimate.from, estimate.to, estimate.first, estimate.last, estimate.exclFirst, and estimate.exclLast; where estimate.from and estimate.to have priority over the remaining span control variables, estimate.last and estimate.first have priority over estimate.exclFirst and estimate.exclLast, and estimate.last has priority over estimate.first.

estimate.from a character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). It can be combined with the parameter estimate.to.

estimate.to a character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with the parameter estimate.from.

estimate.first a numeric specifying the number of periods considered at the beginning of the series.

estimate.last numeric specifying the number of periods considered at the end of the series.

estimate.exclFirst a numeric specifying the number of periods excluded at the beginning of the series. It can be combined with the parameter estimate.exclLast.

estimate.exclLast a numeric specifying the number of periods excluded at the end of the series. It can be combined with the parameter estimate.exclFirst.

estimate.tol a numeric, convergence tolerance. The absolute changes in the log-likelihood function are compared to this value to check for the convergence of the estimation iterations.

transform.function the transformation of the input series: "None" = no transformation of the series; "Log" = takes the log of the series; "Auto" = the program tests for the log-level specification.

transform.adjust pre-adjustment of the input series for the length of period or leap year effects: "None" = no adjustment; "LeapYear" = leap year effect; "LengthOfPeriod" = length of period. Modifications of this variable are taken into account only when transform.function is set to "Log".

transform.aicdiff a numeric defining the difference in AICC needed to accept no transformation when the automatic transformation selection is chosen (considered only when transform.function is set to "Auto").
Control variables for the pre-specified outliers. The pre-specified outliers are used in the model only when enabled (usrdef.outliersEnabled=TRUE) and the outliers' type (usrdef.outliersType) and date (usrdef.outliersDate) are provided.

usrdef.outliersEnabled
   logical. If TRUE, the program uses the pre-specified outliers.

usrdef.outliersType
   a vector defining the outliers' type. Possible types are: ("AO") = additive, ("LS") = level shift, ("TC") = transitory change, ("SO") = seasonal outlier. E.g.: usrdef.outliersType = c("AO","AO","LS").

usrdef.outliersDate
   a vector defining the outliers' dates. The dates should be characters in format "YYYY-MM-DD". E.g.: usrdef.outliersDate= c("2009-10-01","2005-02-01","2003-04-01").

usrdef.outliersCoef
   a vector providing fixed coefficients for the outliers. The coefficients can't be fixed if transform.function is set to "Auto" i.e. the series transformation need to be pre-defined. E.g.: usrdef.outliersCoef=c(200,170,20).

Control variables for the user-defined variables:

usrdef.varEnabled
   a logical. If TRUE, the program uses the user-defined variables.

usrdef.var
   a time series (ts) or a matrix of time series (mts) with the user-defined variables.

usrdef.varType
   a vector of character(s) defining the user-defined variables component type. Possible types are: "Undefined", "Series", "Trend", "Seasonal", "SeasonallyAdjusted", "Irregular", "Calendar". The type "Calendar" must be used with tradingdays.option = "UserDefined" to use user-defined calendar regressors. If not specified, the program will assign the "Undefined" type.

usrdef.varCoef
   a vector providing fixed coefficients for the user-defined variables. The coefficients can't be fixed if transform.function is set to "Auto" i.e. the series transformation need to be pre-defined.

tradingdays.option
   to specify the set of trading days regression variables: "TradingDays" = six day-of-the-week regression variables; "WorkingDays" = one working/non-working day contrast variable; "None" = no correction for trading days and working days effects; "UserDefined" = user-defined trading days regressors (regressors must be defined by the usrdef.var argument with usrdef.varType set to "Calendar" and usrdef.varEnabled = TRUE). "None" must also be specified for the "day-of-week effects" correction (tradingdays.stocktd to be modified accordingly).

tradingdays.autoadjust
   a logical. If TRUE, the program corrects automatically for the leap year effect. Modifications of this variable are taken into account only when transform.function is set to "Auto".

tradingdays.leapyear
   a character to specify whether or not to include the leap-year effect in the model: "LeapYear" = leap year effect; "LengthOfPeriod" = length of period, "None" = no effect included. The leap-year effect can be pre-specified in the
model only if the input series hasn’t been pre-adjusted (transform.adjust set to "None") and if the automatic correction for the leap-year effect isn’t selected (tradingdays.autoadjust set to FALSE).

tradingdays.stocktd

a numeric indicating the day of the month when inventories and other stock are reported (to denote the last day of the month, set the variable to 31). Modifications of this variable are taken into account only when tradingdays.option is set to "None".

tradingdays.test

defines the pre-tests for the significance of the trading day regression variables based on the AICC statistics: "Add" = the trading day variables are not included in the initial regression model but can be added to the RegARIMA model after the test; "Remove" = the trading day variables belong to the initial regression model but can be removed from the RegARIMA model after the test; "None" = the trading day variables are not pre-tested and are included in the model.

easter.enabled

a logical. If TRUE, the program considers the Easter effect in the model.

easter.julian

a logical. If TRUE, the program uses the Julian Easter (expressed in Gregorian calendar).

easter.duration

a numeric indicating the duration of the Easter effect (length in days, between 1 and 20).

easter.test

defines the pre-tests for the significance of the Easter effect based on the t-statistic (the Easter effect is considered as significant if the t-statistic is greater than 1.96): "Add" = the Easter effect variable is not included in the initial regression model but can be added to the RegARIMA model after the test; "Remove" = the Easter effect variable belongs to the initial regression model but can be removed from the RegARIMA model after the test; "None" = the Easter effect variable is not pre-tested and is included in the model.

outlier.enabled

a logical. If TRUE, the automatic detection of outliers is enabled in the defined time span.

The time span during which outliers will be searched is controlled by the following six variables: outlier.from, outlier.to, outlier.first, outlier.last, outlier.exclFirst and outlier.exclLast; where outlier.from and outlier.to have priority over the remaining span control variables, outlier.last and outlier.first have priority over outlier.exclFirst and outlier.exclLast, and outlier.last has priority over outlier.first.

outlier.from

a character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). It can be combined with the parameter outlier.to.

outlier.to

a character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with the parameter outlier.from.

outlier.first

a numeric specifying the number of periods considered at the beginning of the series.

outlier.last

a numeric specifying the number of periods considered at the end of the series.

outlier.exclFirst

a numeric specifying the number of periods excluded at the beginning of the series. It can be combined with the parameter outlier.exclLast.
outlier.exclLast

A numeric specifying the number of periods excluded at the end of the series. It can be combined with the parameter outlier.exclFirst.

outlier.ao

A logical. If TRUE, the automatic detection of additive outliers is enabled (outlier.enabled must be also set to TRUE).

outlier.tc

A logical. If TRUE, the automatic detection of transitory changes is enabled (outlier.enabled must be also set to TRUE).

outlier.ls

A logical. If TRUE, the automatic detection of level shifts is enabled (outlier.enabled must be also set to TRUE).

outlier.so

A logical. If TRUE, the automatic detection of seasonal outliers is enabled (outlier.enabled must be also set to TRUE).

outlier.usedefcv

A logical. If TRUE, the critical value for the outlier detection procedure is automatically determined by the number of observations in the outlier detection time span. If FALSE, the procedure uses the entered critical value (outlier.cv).

outlier.cv

A numeric. The entered critical value for the outlier detection procedure. The modification of this variable is only taken into account when outlier.usedefcv is set to FALSE.

outlier.method

determines how the program successively adds detected outliers to the model. At present, only the AddOne method is supported.

outlier.tcrate

A numeric. The rate of decay for the transitory change outlier.

automdl.enabled

A logical. If TRUE, the automatic modelling of the ARIMA model is enabled. If FALSE, the parameters of the ARIMA model can be specified.

Control variables for the automatic modelling of the ARIMA model (when automdl.enabled is set to TRUE):

automdl.acceptdefault

A logical. If TRUE, the default model (ARIMA(0,1,1)(0,1,1)) may be chosen in the first step of the automatic model identification. If the Ljung-Box Q statistics for the residuals is acceptable, the default model is accepted and no further attempt will be made to identify another model.

automdl.cancel

The cancelation limit (numeric). If the difference in moduli of an AR and an MA roots (when estimating ARIMA(1,0,1)(1,0,1) models in the second step of the automatic identification of the differencing orders) is smaller than the cancelation limit, the two roots are assumed equal and cancel out.

automdl.ub1

The first unit root limit (numeric). It is the threshold value for the initial unit root test in the automatic differencing procedure. When one of the roots in the estimation of the ARIMA(2,0,0)(1,0,0) plus mean model, performed in the first step of the automatic model identification procedure, is larger than the first unit root limit in modulus, it is set equal to unity.

automdl.ub2

The second unit root limit (numeric). When one of the roots in the estimation of the ARIMA(1,0,1)(1,0,1) plus mean model, which is performed in the second step of the automatic model identification procedure, is larger than second unit root limit in modulus, it is checked if there is a common factor in the corresponding AR and MA polynomials of the ARMA model that can be cancelled.
(see automdl.cancel). If there is no cancellation, the AR root is set equal to unity (i.e. the differencing order changes).

**automdl.mixed**

a logical. This variable controls whether ARIMA models with non-seasonal AR and MA terms or seasonal AR and MA terms will be considered in the automatic model identification procedure. If FALSE, a model with AR and MA terms in both the seasonal and non-seasonal parts of the model can be acceptable, provided there are no AR or MA terms in either the seasonal or non-seasonal terms.

**automdl.balanced**

a logical. If TRUE, the automatic model identification procedure will have a preference for balanced models (i.e. models for which the order of the combined AR and differencing operator is equal to the order of the combined MA operator).

**automdl.armalimit**

the ARMA limit (numeric). It is the threshold value for t-statistics of ARMA coefficients and constant term used for the final test of model parsimony. If the highest order ARMA coefficient has a t-value smaller than this value in magnitude, the order of the model is reduced. If the constant term t-value is smaller than the ARMA limit in magnitude, it is removed from the set of regressors.

**automdl.reducecv**

numeric, ReduceCV. The percentage by which the outlier’s critical value will be reduced when an identified model is found to have a Ljung-Box statistic with an unacceptable confidence coefficient. The parameter should be between 0 and 1, and will only be active when automatic outlier identification is enabled. The reduced critical value will be set to (1-ReduceCV)*CV, where CV is the original critical value.

**automdl.ljungboxlimit**

the Ljung Box limit (numeric). Acceptance criterion for the confidence intervals of the Ljung-Box Q statistic. If the LjungBox Q statistics for the residuals of a final model is greater than the Ljung Box limit, then the model is rejected, the outlier critical value is reduced and model and outlier identification (if specified) is redone with a reduced value.

**automdl.ubfinal**

numeric, final unit root limit. The threshold value for the final unit root test. If the magnitude of an AR root for the final model is smaller than the final unit root limit, then a unit root is assumed, the order of the AR polynomial is reduced by one and the appropriate order of the differencing (non-seasonal, seasonal) is increased. The parameter value should be greater than one.

Control variables for the non-automatic modelling of the ARIMA model (when automdl.enabled is set to FALSE):

**arima.mu**

logical. If TRUE, the mean is considered as part of the ARIMA model.

**arima.p**

numeric. The order of the non-seasonal autoregressive (AR) polynomial.

**arima.d**

numeric. The regular differencing order.

**arima.q**

numeric. The order of the non-seasonal moving average (MA) polynomial.

**arima.bp**

numeric. The order of the seasonal autoregressive (AR) polynomial.

**arima.bd**

numeric. The seasonal differencing order.

**arima.bq**

numeric. The order of the seasonal moving average (MA) polynomial.
Control variables for the user-defined ARMA coefficients. Coefficients can be defined for the regular and seasonal autoregressive (AR) polynomials and moving average (MA) polynomials. The model considers the coefficients only if the procedure for their estimation (arima.coefType) is provided, and the number of provided coefficients matches the sum of (regular and seasonal) AR and MA orders (p,q,bp,bq).

arima.coefEnabled
logical. If TRUE, the program uses the user-defined ARMA coefficients.

arima.coef
a vector providing the coefficients for the regular and seasonal AR and MA polynomials. The vector length must be equal to the sum of the regular and seasonal AR and MA orders. The coefficients shall be provided in the following order: regular AR (Phi; p elements), regular MA (Theta; q elements), seasonal AR (BPhi; bp elements) and seasonal MA (BTheta; bq elements). E.g.: arima.coef=c(0.6,0.7) with arima.p=1,arima.q=0,arima.bp=1 and arima.bq=0.

arima.coefType
a vector defining the ARMA coefficients estimation procedure. Possible procedures are: "Undefined" = no use of any user-defined input (i.e. coefficients are estimated), "Fixed" = the coefficients are fixed at the value provided by the user, "Initial" = the value defined by the user is used as the initial condition. For orders for which the coefficients shall not be defined, the arima.coef can be set to NA or 0, or the arima.coefType can be set to "Undefined". E.g.: arima.coef = c(-0.8,-0.6,NA), arima.coefType = c("Fixed","Fixed","Undefined").

fcst.horizon
the forecasting horizon (numeric). The forecast length generated by the RegARIMA model in periods (positive values) or years (negative values). By default, the program generates a two-year forecast (fcst.horizon set to 2).

Details
The available predefined 'JDemetra+' model specifications are described in the table below:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Log/level detection</th>
<th>Outliers detection</th>
<th>Calendar effects</th>
<th>ARIMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RG1</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RG2c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RG3</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>automatic</td>
</tr>
<tr>
<td>RG4c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>RG5c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>7 td vars + Easter</td>
<td>automatic</td>
</tr>
</tbody>
</table>

Value
A list of class c("regarima_spec","x13") with the following components, each referring to a different part of the RegARIMA model specification, mirroring the arguments of the function (for details, see the arguments description). Each lowest-level component (except span, pre-specified outliers, user-defined variables and pre-specified ARMA coefficients) is structured within a data frame with columns denoting different variables of the model specification and rows referring to: first row = base specification, as provided within the argument spec; second row = user modifications as specified by the remaining arguments of the function (e.g.: arima.d); and third row = final model specification, values that will be used in the function regarima. The final specification
(third row) shall include user modifications (row two) unless they were wrongly specified. The pre-specified outliers, user-defined variables and pre-specified ARMA coefficients consist of a list of Predefined (base model specification) and Final values.

**estimate**
a data frame. Variables referring to: span - time span for the model estimation, tolerance - argument estimate.tol. The final values can also be accessed with the function `s_estimate`.

**transform**
a data frame. Variables referring to: tfunction - argument transform.function, adjust - argument transform.adjust, aicdiff - argument transform.aicdiff. The final values can also be accessed with the function `s_transform`.

**regression**
a list containing the information on the user-defined variables (userdef), trading.days effect and easter effect. The user-defined part includes: specification - data frame with the information if pre-specified outliers (outlier) and user-defined variables (variables) are included in the model and if fixed coefficients are used (outlier.coef and variables.coef). The final values can also be accessed with the function `s_userdef`, outliers - matrixes with the outliers (Predefined and Final). The final outliers can also be accessed with the function `s_preOut`, and variables - a list with the Predefined and Final user-defined variables (series) and its description (description) including the information on the variable type and the values of fixed coefficients. The final user-defined variables can also be accessed with the function `s_preVar`. Within the data frame trading.days, the variables refer to: option - argument tradingdays.option, autoadjust - argument tradingdays.autoadjust, leapyear - argument tradingdays.leapyear, stocktd - argument tradingdays.stocktd, test - argument tradingdays.test. The final trading.days values can be also accessed with the function `s_td`. Within the data frame easter variables refer to: enabled - argument easter.enabled, julian - argument easter.julian, duration - argument easter.duration, test - argument easter.test. The final easter values can be also accessed with the function `s_easter`.

**outliers**
a data frame. Variables referring to: enabled - argument outlier.enabled, span - time span for the outliers’ detection, ao - argument outlier.ao, tc - argument outlier.tc, ls - argument outlier.ls, so - argument outlier.so, usedefcv - argument outlier.usedefcv, cv - argument outlier.cv, method - argument outlier.method, tcrate - argument outlier.tcrate. The final values can also be accessed with the function `s_out`.

**arima**
a list of a data frame with the ARIMA settings (specification) and matrixes with the information on the pre-specified ARMA coefficients (coefficients). The matrix Predefined refers to the pre-defined model specification, and the matrix Final to the final specification. Both matrixes contain the value of the ARMA coefficients and the procedure for its estimation. In the data frame specification, the variable enabled refers to the argument autmdl.enabled and all remaining variables (autmdl.acceptdefault, autmdl.cancel, autmdl.ub1, autmdl.ub2, autmdl.ljungboxlimit, autmdl.ubfinal, arima.mu, arima.p, arima.d, arima.q, arima.bp, arima.bd, arima.bq) to the respective function arguments. The final values of the specification can be also accessed with the function `s_arima` and the final pre-specified ARMA coefficients, with the function `s_arimaCoef`.

**forecast**
a data frame with the forecast horizon (argument fcst.horizon). The final value can also be accessed with the function `s_fcst`.
span a matrix containing the final time span for the model estimation and outliers’ detection. It contains the same information as the variable span in the data frames estimate and outliers. The matrix can be also accessed with the function \texttt{s_span}.

References

Info on 'JDemetra+', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/

Examples

\begin{verbatim}
myseries <- ipi_c_eu[, "FR"]
myspec1 <- regarima_spec_x13(spec = "RG5c")
myreg1 <- regarima(myseries, spec = myspec1)

# To modify a pre-specified model specification
myspec2 <- regarima_spec_x13(spec = "RG5c",
   tradingdays.option = "WorkingDays")
myreg2 <- regarima(myseries, spec = myspec2)

# To modify the model specification of a "regarima" object
myspec3 <- regarima_spec_x13(myreg1, tradingdays.option = "WorkingDays")
myreg3 <- regarima(myseries, myspec3)

# To modify the model specification of a "regarima_spec" object
myspec4 <- regarima_spec_x13(myspec1, tradingdays.option = "WorkingDays")
myreg4 <- regarima(myseries, myspec4)

# Pre-specified outliers
myspec1 <- regarima_spec_x13(spec = "RG5c", 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")

myreg1 <- regarima(myseries, myspec1)
myreg1
s_preOut(myreg1)

# User-defined variables
var1 <- ts(rnorm(length(myseries))*10, start = start(myseries),
   frequency = 12)
var2 <- ts(rnorm(length(myseries))*100, start = start(myseries),
   frequency = 12)
var <- ts.union(var1, var2)

myspec1 <- regarima_spec_x13(spec = "RG5c", usrdef.varEnabled = TRUE,
   usrdef.var = var)
myreg1 <- regarima(myseries, myspec1)
myreg1
\end{verbatim}
myspec2 <- regarima_spec_x13(spec = "RG5c", usrdef.varEnabled = TRUE, 
usrdef.var = var1, usrdef.varCoef = 2, 
transform.function = "None")

myreg2 <- regarima(myseries, myspec2)
s_preVar(myreg2)

# Pre-specified ARMA coefficients
myspec1 <- regarima_spec_x13(spec = "RG5c", automdl.enabled = FALSE, 
arima.p = 1, arima.q = 1, arima.bp = 0, arima.bq = 1, 
arima.coefEnabled = TRUE, arima.coef = c(-0.8, -0.6, 0), 
arima.coefType = c(rep("Fixed", 2), "Undefined"))

s_arimaCoef(myspec1)

myreg1 <- regarima(myseries, myspec1)
myreg1

save_spec

Saving and loading a model specification, SA and pre-adjustment in X13 and TRAMO-SEATS

Description

save_spec saves a SA or RegARIMA model specification. load_spec loads the previously saved model specification.

Usage

save_spec(object, file = file.path(tempdir(), "spec.RData"))

load_spec(file = "spec.RData")

Arguments

object an object of one of the following classes: c("SA_spec","X13"), c("SA_spec","TRAMO_SEATS"), c("SA","X13"), c("SA","TRAMO_SEATS"), c("regarima_spec","X13"), c("regarima_spec","TRAMO_SEATS"), c("regarima","X13"), c("regarima","TRAMO_SEATS").

file the (path and) name of the file where the model specification will be/has been saved.

Details

save_spec saves the final model specification of a "SA_spec", "SA", "regarima_spec" or "regarima" class object. load_spec loads the previously saved model specification. It creates a c("SA_spec","X13"), c("SA_spec","TRAMO_SEATS"), c("regarima_spec","X13") or c("regarima_spec","TRAMO_SEATS") class object, in line with the class of the previously saved model specification.
Value

load_spec returns an object of class "SA_spec" or "regarima_spec".

References

Info on JDemetra+, usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/

Examples

myseries <- ipi_c_eu[, "FR"]
myreg1 <- regarima_x13(myseries, spec = "RG5c")
myspec2 <- regarima_spec_x13(myreg1, estimate.from = "2005-10-01", outlier.from = "2010-03-01")
myreg2 <- regarima(myseries, myspec2)

myreg3 <- regarima_tramoseats(myseries, spec = "TRfull")
myspec4 <- regarima_spec_tramoseats(myreg3, tradingdays.mauto = "Unused",
                                   tradingdays.option = "WorkingDays",
                                   easter.type = "Standard",
                                   automdl.enabled = FALSE, arima.mu = TRUE)

myreg4 <- regarima(myseries, myspec4)

myspec6 <- x13_spec("RSA5c")
mya6 <- x13(myseries, myspec6)

myspec7 <- tramoseats_spec("RSAfull")
mya7 <- tramoseats(myseries, myspec7)

dir <- tempdir()

# To save the model specification of a c("regarima_spec","X13") class object
save_spec(myspec2, file.path(dir, "specx13.RData"))
# To save the model specification of a c("regarima","X13") class object
save_spec(myreg2, file.path(dir, "regx13.RData"))
# To save the model specification of a c("regarima_spec","TRAMO_SEATS") class object
save_spec(myspec4, file.path(dir, "specTS.RData"))
# To save the model specification of a c("regarima","TRAMO_SEATS") class object
save_spec(myreg4, file.path(dir, "regTS.RData"))
# To save the model of a c("SA_spec","X13") class object
save_spec(myspec6, file.path(dir, "specFullx13.RData"))
# To save the model of a c("SA","X13") class object
save_spec(myspec6, file.path(dir, "specFullx13.RData"))
# To save the model of a c("SA_spec","TRAMO_SEATS") class object
save_spec(myspec7, file.path(dir, "specFullTS.RData"))
# To save the model of a c("SA","TRAMO_SEATS") class object
save_spec(myspec7, file.path(dir, "saTS.RData"))

# To load a model specification:
myspec2a <- load_spec(file.path(dir, "specx13.RData"))
myspec2b <- load_spec(file.path(dir, "regx13.RData"))
myspec4a <- load_spec(file.path(dir, "specTS.RData"))
save_workspace

myspec4b <- load_spec(file.path(dir,"regTS.RData"))
myspec6a <- load_spec(file.path(dir,"specFullx13.RData"))
myspec6b <- load_spec(file.path(dir,"sax13.RData"))
myspec7a <- load_spec(file.path(dir,"specFullTS.RData"))
myspec7b <- load_spec(file.path(dir,"saTS.RData"))

# To use the re-loaded specifications and models:
regarima(myseries, myspec2a)
x13(myseries, myspec6a)
tramoseats(myseries, myspec7a)

regarima(myseries, myspec4a)
x13(myseries, myspec6b)
tramoseats(myseries, myspec7b)

save_workspace

Description
Function to save a workspace object into a 'JDemetra+' workspace.

Usage
save_workspace(workspace, file)

Arguments
workspace the workspace object to export
file the path where to export the 'JDemetra+' workspace (.xml file). By default, if not specified, a dialog box opens.

Value
A boolean indicating whether the export is successful.

See Also
load_workspace

Examples

dir <- tempdir()
# Creation and export of an empty 'JDemetra+' workspace
wk <- new_workspace()
new_multiprocessing(wk, "sa1")
save_workspace(wk, file.path(dir, "workspace.xml"))
The following functions enable the access to different parts of the final model specification, as included in the "SA", "regarima", "SA_spec" and "regarima_spec" S3 class objects.

Usage

s_estimate(object = NA)
s_transform(object = NA)
s_usrdef(object = NA)
s_preOut(object = NA)
s_preVar(object = NA)
s_td(object = NA)
s_easter(object = NA)
s_out(object = NA)
s_arima(object = NA)
s_arimaCoef(object = NA)
s_fcst(object = NA)
s_span(object = NA)
s_x11(object = NA)
s_seats(object = NA)

Arguments

object an object of one of the following classes: c("SA", "X13"), c("SA", "TRAMO_SEATS"), c("SA_spec", "X13"), c("SA_spec", "TRAMO_SEATS"), c("regarima", "X13"), c("regarima", "TRAMO_SEATS"), c("regarima_spec", "X13"), c("regarima_spec", "TRAMO_SEATS")

Value

• s_estimate returns a data.frame with the estimate variables
• `s_transform` returns a data.frame with the *transform* variables
• `s_usrdef` returns a data.frame with the *user-defined regressors* (outliers and variables) model specification, indicating if those variables are included in the model and if coefficients are pre-specified
• `s_preOut` returns a data.frame with the *pre-specified outliers*
• `s_preVar` returns a list with information on the user-defined variables, including: series - the time series and description - data.frame with the variable type and coefficients
• `s_td` returns a data.frame with the *trading.days* variables
• `s_easter` returns a data.frame with the *easter* variable
• `s_out` returns a data.frame with the *outliers* detection variables
• `s_arima` returns a data.frame with the *arima* variables
• `s_arimaCoef` returns a data.frame with the user-specified ARMA coefficients
• `s_fcst` returns a data.frame with the forecast horizon
• `s_span` returns a data.frame with the *span* variables
• `s_x11` returns a data.frame with the *x11* variables
• `s_seats` returns a data.frame with the *seats* variables

References

Info on 'JDemetra+', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/

Examples

```r
myseries <- ipi_c_eu[, "FR"]
myreg1 <- regarima_x13(myseries, spec = "RG5c")
myspec1 <- regarima_spec_x13(myreg1,
    estimate.from = "2005-10-01",
    outlier.from = "2010-03-01")

s_estimate(myreg1)
s_estimate(myspec1)

s_transform(myreg1)
s_transform(myspec1)

s_usrdef(myreg1)
s_usrdef(myspec1)

myspec2 <- regarima_spec_x13(myreg1, usrdef.outliersEnabled = TRUE,
    usrdef.outliersType = c("LS", "AO"),
    usrdef.outliersDate = c("2009-10-01", "2005-02-01"))
myreg2 <- regarima(myseries, myspec2)

s_preOut(myreg2)
s_preOut(myspec2)
```
```r
var1 <- ts(rnorm(length(myseries)) * 10, start = start(myseries), frequency = 12)
var2 <- ts(rnorm(length(myseries)) * 100, start = start(myseries), frequency = 12)
var3 <- ts.union(var1, var2)
myspec3 <- regarima_spec_x13(spec = "RG5c",
                           usrdef.varEnabled = TRUE,
                           usrdef.var = var3)
myreg3 <- regarima(myseries, myspec3)
s_preVar(myspec3)
s_preVar(myreg3)
s_td(myreg1)
s_td(myspec1)
s_easter(myreg1)
s_easter(myspec1)
s_out(myreg1)
s_out(myspec1)
s_arima(myreg1)
s_arima(myspec1)

myspec4 <- regarima_spec_x13(myreg1, automdl.enabled = FALSE,
                           arima.coefEnabled = TRUE,
                           arima.p = 1, arima.q = 1, arima.bp = 1, arima.bq = 1,
                           arima.coef = rep(0.2, 4),
                           arima.coefType = rep("Initial", 4))
myreg4 <- regarima(myseries, myspec4)
s_arimaCoef(myreg4)
s_arimaCoef(myspec4)
s_fcst(myreg1)
s_fcst(myspec1)
s_span(myreg1)
s_span(myspec1)

myspec5 <- x13_spec(spec = "RSA5c", x11.seasonalComp = FALSE)
mysa5 <- x13(myseries, myspec5)
s_x11(mysa5)
s_x11(myspec5)

myspec6 <- tramoseats_spec(spec = "RSAfull", seats.approx = "Noisy")
mysa6 <- tramoseats(myseries, myspec6)
s_seats(mysa6)
s_seats(myspec6)
```
Description

Function to estimate the seasonally adjusted series (sa) with the TRAMO-SEATS method. This is achieved by decomposing the time series (y) into the: trend-cycle (t), seasonal component (s) and irregular component (i). The final seasonally adjusted series shall be free of seasonal and calendar-related movements. tramoseats returns a preformatted result while jtramoseats returns the Java objects of the seasonal adjustment.

Usage

jtramoseats(
  series,
  spec = c("RSAfull", "RSA0", "RSA1", "RSA2", "RSA3", "RSA4", "RSA5"),
  userdefined = NULL
)

tramoseats(
  series,
  spec = c("RSAfull", "RSA0", "RSA1", "RSA2", "RSA3", "RSA4", "RSA5"),
  userdefined = NULL
)

Arguments

- **series**: a univariate time series
- **spec**: a TRAMO-SEATS model specification. It can be the name (character) of a pre-defined TRAMO-SEATS 'JDemetra+' model specification (see Details), or an object of class c("SA_spec", "TRAMO_SEATS"). The default value is "RSAfull".
- **userdefined**: a character vector containing the additional output variables (see user_defined_variables).

Details

The first step of a seasonal adjustment consist in pre-adjusting the time series. This is done by removing its deterministic effects, using a regression model with ARIMA noise (RegARIMA, see: regarima). In the second part, the pre-adjusted series is decomposed into the following components: trend-cycle (t), seasonal component (s) and irregular component (i). The decomposition can be: additive \( y = t + s + i \) or multiplicative \( y = t \times s \times i \). The final seasonally adjusted series (sa) shall be free of seasonal and calendar-related movements.

In the TRAMO-SEATS method, the second step - SEATS ("Signal Extraction in ARIMA Time Series") - performs an ARIMA-based decomposition of an observed time series into unobserved components. More information on the method can be found on the Bank of Spain website (https://www.bde.es/bde/es/).
The available predefined 'JDemetra+' TRAMO-SEATS model specifications are described in the table below:
### Value

tramoseats returns a jSA object that contains the results of the seasonal adjustment without any formatting. Therefore, the computation is faster than with the function tramoseats. The results of the seasonal adjustment can be extracted with the function `get_indicators`.

tramoseats returns an object of class c("SA","TRAMO_SEATS"), that is, a list containing:

- **regarima** an object of class c("regarima","TRAMO_SEATS"). More info in the *Value* section of the function `regarima`.
- **decomposition** an object of class "decomposition_SEATS", that is a five-element list:
  - **specification** a list with the SEATS algorithm specification. See also the function `tramoseats_spec`.
  - **mode** the decomposition mode
  - **model** the SEATS model list: model, sa, trend, seasonal, transitory, irregular, each element being a matrix of estimated coefficients.
  - **linearized** the time series matrix (mts) with the stochastic series decomposition (input series y_lin, seasonally adjusted series sa_lin, trend t_lin, seasonal s_lin, irregular i_lin)
  - **components** the time series matrix (mts) with the decomposition components (input series y_cmp, seasonally adjusted series sa_cmp, trend t_cmp, seasonal component s_cmp, irregular i_cmp)
- **final** an object of class c("final","mts","ts","matrix"). The matrix contains the final results of the seasonal adjustment: the original time series (y) and its forecast (y_f), the trend (t) and its forecast (t_f), the seasonally adjusted series (sa) and its forecast (sa_f), the seasonal component (s) and its forecast (s_f), and the irregular component (i) and its forecast (i_f).
- **diagnostics** an object of class "diagnostics", that is a list containing three types of tests results:
  - **variance_decomposition** a data.frame with the tests results on the relative contribution of the components to the stationary portion of the variance in the original series, after the removal of the long term trend;
  - **residuals_test** a data.frame with the tests results of the presence of seasonality in the residuals (including the statistic test values, the corresponding p-values and the parameters description);
  - **combined_test** the combined tests for stable seasonality in the entire series. The format is a two elements list with: tests_for_stable_seasonality, a data.frame containing the tests results (including the statistic test value, its
p-value and the parameters description), and combined_seasonality_test, the summary.

user_defined an object of class "user_defined": a list containing the additional userdefined variables.

References

Info on 'JDemetra+', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/


See Also

tramoseats_spec, x13

Examples

#Example 1
myseries <- ipi_c_eu[, "FR"]
myspec <- tramoseats_spec("RSAfull")
myesa <- tramoseats(myseries, myspec)
myesa

# Equivalent to:
mysa1 <- tramoseats(myseries, spec = "RSAfull")
myesa1

#Example 2
var1 <- ts(rnorm(length(myseries)) * 10, start = start(myseries), frequency = 12)
var2 <- ts(rnorm(length(myseries)) * 100, start = start(myseries), frequency = 12)
var <- ts.union(var1, var2)
myspec2 <- tramoseats_spec(myspec, tradingdays.mauto = "Unused",
 tradingdays.option = "WorkingDays",
easter.type = "Standard",
automdl.enabled = FALSE, arima.mu = TRUE,
usrdef.varEnabled = TRUE, usrdef.var = var)
s.preVar(myspec2)
myesa2 <- tramoseats(myseries, myspec2,
 userdefined = c("decomposition.sa_lin_f",
 "decomposition.sa_lin_e"))
myesa2
plot(mysa2)
plot(mysa2$regarima)
plot(mysa2$decomposition)
**Description**

Function to create (and/or modify) a c("SA_spec","TRAMO_SEATS") class object with the SA model specification for the TRAMO-SEATS method. It can be done from a pre-defined 'IDemeta+' model specification (a character), a previous specification (c("SA_spec","TRAMO_SEATS") object) or a seasonal adjustment model (c("SA","TRAMO_SEATS") object).

**Usage**

```r
tramoseats_spec(
  spec = c("RSAfull", "RSA0", "RSA1", "RSA2", "RSA3", "RSA4", "RSA5"),
  preliminary.check = NA,
  estimate.from = NA_character_,
  estimate.to = NA_character_,
  estimate.first = NA_integer_,
  estimate.last = NA_integer_,
  estimate.exclFirst = NA_integer_,
  estimate.exclLast = NA_integer_,
  estimate.tol = NA_integer_,
  estimate.eml = NA,
  estimate.urfinal = NA_integer_,
  transform.function = c(NA, "Auto", "None", "Log"),
  transform.fct = NA_integer_,
  usrdef.outliersEnabled = NA,
  usrdef.outliersType = NA,
  usrdef.outliersDate = NA,
  usrdef.outliersCoef = NA,
  usrdef.varEnabled = NA,
  usrdef.var = NA,
  usrdef.varType = NA,
  usrdef.varCoef = NA,
  tradingdays.mauto = c(NA, "Unused", "FTest", "WaldTest"),
  tradingdays.pftd = NA_integer_,
  tradingdays.option = c(NA, "TradingDays", "WorkingDays", "UserDefined", "None"),
  tradingdays.leapyear = NA,
  tradingdays.stocktd = NA_integer_,
  tradingdays.test = c(NA, "Separate_T", "Joint_F", "None"),
  easter.type = c(NA, "Unused", "Standard", "IncludeEaster", "IncludeEasterMonday"),
  easter.julian = NA,
  easter.duration = NA_integer_,
  outlier.enabled = NA,
  outlier.from = NA_character_,
  outlier.to = NA_character_,
)```
outlier.first = NA_integer_,
outlier.last = NA_integer_,
outlier.exclFirst = NA_integer_,
outlier.exclLast = NA_integer_,
outlier.ao = NA,
outlier.tc = NA,
outlier.ls = NA,
outlier.so = NA,
outlier.usedefcv = NA,
outlier.cv = NA_integer_,
outlier.eml = NA,
outlier.tcrate = NA_integer_,
automdl.enabled = NA,
automdl.acceptdefault = NA,
automdl.cancel = NA_integer_,
automdl.ub1 = NA_integer_,
automdl.ub2 = NA_integer_,
automdl.armalimit = NA_integer_,
automdl.reducecv = NA_integer_,
automdl.ljungboxlimit = NA_integer_,
automdl.compare = NA,
arima.mu = NA,
arima.p = NA_integer_,
arima.d = NA_integer_,
arima.q = NA_integer_,
arima.bp = NA_integer_,
arima.bd = NA_integer_,
arima.bq = NA_integer_,
arima.coefEnabled = NA,
arima.coef = NA,
arima.coefType = NA,
fcs.horizon = NA_integer_,
seats.predictionLength = NA_integer_,
seats.approx = c(NA, "None", "Legacy", "Noisy"),
seats.trendBoundary = NA_integer_,
seats.seasdBoundary = NA_integer_,
seats.seasdBoundary1 = NA_integer_,
seats.seasTol = NA_integer_,
seats.maBoundary = NA_integer_,
seats.method = c(NA, "Burman", "KalmanSmoother", "McElroyMatrix")
)

Arguments

spec a TRAMO-SEATS model specification. It can be the 'JDemetra+' name (character) of a predefined TRAMO-SEATS model specification (see Details), an object of class c("SA_spec", "TRAMO_SEATS") or an object of class c("SA", "TRAMO_SEATS"). The default is "RSAfull".
preliminary.check

A logical to check the quality of the input series and exclude highly problematic series e.g. the series with a number of identical observations and/or missing values above pre-specified threshold values.

The time span of the series to be used for the estimation of the RegArima model coefficients is controlled by the following six variables: estimate.from, estimate.to, estimate.first, estimate.last, estimate.exclFirst, and estimate.exclLast; where estimate.from and estimate.to have priority over remaining span control variables, estimate.last and estimate.first have priority over estimate.exclFirst and estimate.exclLast, and estimate.first has priority over estimate.first.

estimate.from

A character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). Can be combined with estimate.to.

estimate.to

A character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with the parameter estimate.from.

estimate.first

Numeric, the number of periods considered at the beginning of the series.

estimate.last

Numeric, the number of periods considered at the end of the series.

estimate.exclFirst

Numeric, the number of periods excluded at the beginning of the series. It can be combined with the parameter estimate.exclLast.

estimate.exclLast

Numeric, the number of periods excluded at the end of the series. It can be combined with the parameter estimate.exclFirst.

estimate.tol

Numeric, the convergence tolerance. The absolute changes in the log-likelihood function are compared to this value to check for the convergence of the estimation iterations.

estimate.eml

Logical, the exact maximum likelihood estimation. If TRUE, the program performs an exact maximum likelihood estimation. If FALSE, the Unconditional Least Squares method is used.

estimate.urfinal

Numeric, the final unit root limit. The threshold value for the final unit root test for identification of differencing orders. If the magnitude of an AR root for the final model is smaller than this number, then a unit root is assumed, the order of the AR polynomial is reduced by one and the appropriate order of the differencing (non-seasonal, seasonal) is increased.

transform.function

The transformation of the input series: "None" = no transformation of the series; "Log" = takes the log of the series; "Auto" = the program tests for the log-level specification.

transform.fct

Numeric controlling the bias in the log/level pre-test: transform.fct > 1 favours levels, transform.fct < 1 favours logs. Considered only when transform.function is set to "Auto".

Control variables for the pre-specified outliers. Said pre-specified outliers are used in the model only when enabled (usrdef.outliersEnabled=TRUE) and when the outliers' type (usrdef.outliersType) and date (usrdef.outliersDate) are provided.
usrdef.outliersEnabled
   logical. If TRUE, the program uses the pre-specified outliers.

usrdef.outliersType
   a vector defining the outliers' type. Possible types are: ("AO") = additive,
   ("LS") = level shift, ("TC") = transitory change, ("SO") = seasonal outlier. E.g.:
usrdef.outliersType= c("AO","AO","LS").

usrdef.outliersDate
   a vector defining the outliers' date. The dates should be characters in format
   "YYYY-MM-DD". E.g.: usrdef.outliersDate= c("2009-10-01","2005-02-01","2003-04-01").

usrdef.outliersCoef
   a vector providing fixed coefficients for the outliers. The coefficients can't be
   fixed if the parameter transform.function is set to "Auto" (i.e. if the se-
   ries transformation needs to be pre-defined.) E.g.: usrdef.outliersCoef=
   c(200,170,20).

Control variables for the user-defined variables:

usrdef.varEnabled
   logical If TRUE, the program uses the user-defined variables.

usrdef.var
   a time series (ts) or a matrix of time series (mts) containing the user-defined
   variables.

usrdef.varType
   a vector of character(s) defining the user-defined variables component type. Pos-
   sible types are: "Undefined","Series","Trend","Seasonal","SeasonallyAdjusted","Irregular"
   To use the user-defined calendar regressors, the type "Calendar" must be de-
   fined in conjunction with tradingdays.option = "UserDefined". Otherwise,
   the program will automatically set usrdef.varType = "Undefined".

usrdef.varCoef
   a vector providing fixed coefficients for the user-defined variables. The coeffi-
   cients can't be fixed if transform.function is set to "Auto" (i.e. if the series
   transformation needs to be pre-defined).

tradingdays.mauto
   defines whether the calendar effects should be added to the model manually
   ("Unused") or automatically. During the automatic selection, the choice of the
   number of calendar variables can be based on the F-Test ("FTest") or the Wald
   Test ("WaldTest"); the model with higher F value is chosen, provided that it is
   higher than tradingdays.pftd).

tradingdays.pftd
   numeric. The p-value used in the test specified by the automatic parameter
   (tradingdays.mauto) to assess the significance of the pre-tested calendar ef-
   fects variables and whether they should be included in the RegArima model.
   Control variables for the manual selection of calendar effects variables (tradingdays.mauto
   is set to "Unused"):

tradingdays.option
   to choose the trading days regression variables: "TradingDays" = six day-
   of-the-week regression variables; "WorkingDays" = one working/non-working
day contrast variable; "None" = no correction for trading days and working
days effects; "UserDefined" = user-defined trading days regressors (regres-
sors must be defined by the usrdef.var argument with usrdef.varType set
to "Calendar" and usrdef.varEnabled = TRUE). "None" must also be chosen
for the "day-of-week effects" correction (and tradingdays.stocktd must be modified accordingly).

tradingdays.leapyear
    logical. Specifies if the leap-year correction should be included. If TRUE, the model includes the leap-year effect.

tradingdays.stocktd
    numeric indicating the day of the month when inventories and other stock are reported (to denote the last day of the month set the variable to 31). Modifications of this variable are taken into account only when tradingdays.option is set to "None".

tradingdays.test
    defines the pre-tests of the trading day effects: "None" = calendar variables are used in the model without pre-testing; "Separate_T" = a t-test is applied to each trading day variable separately and the trading day variables are included in the RegArima model if at least one t-statistic is greater than 2.6 or if two t-statistics are greater than 2.0 (in absolute terms); "Joint_F" = a joint F-test of significance of all the trading day variables. The trading day effect is significant if the F statistic is greater than 0.95.

easter.type
    a character that specifies the presence and the length of the Easter effect: "Unused" = the Easter effect is not considered; "Standard" = influences the period of \( n \) days strictly before Easter Sunday; "IncludeEaster" = influences the entire period (\( n \)) up to and including Easter Sunday; "IncludeEasterMonday" = influences the entire period (\( n \)) up to and including Easter Monday.

easter.julian
    logical. If TRUE, the program uses the Julian Easter (expressed in Gregorian calendar).

easter.duration
    numeric indicating the duration of the Easter effect (length in days, between 1 and 15).

easter.test
    logical. If TRUE, the program performs a t-test for the significance of the Easter effect. The Easter effect is considered as significant if the modulus of t-statistic is greater than 1.96.

outlier.enabled
    logical. If TRUE, the automatic detection of outliers is enabled in the defined time span.

    The time span of the series to be searched for outliers is controlled by the following six variables: outlier.from, outlier.to, outlier.first, outlier.last, outlier.exclFirst and outlier.exclLast; where outlier.from and outlier.to have priority over the remaining span control variables, outlier.last and outlier.first have priority over outlier.exclFirst and outlier.exclLast, and outlier.last has priority over outlier.first.

outlier.from
    a character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). It can be combined with outlier.to.

outlier.to
    a character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). It can be combined with outlier.from.

outlier.first
    numeric specifying the number of periods considered at the beginning of the series.
outlier.last numeric specifying the number of periods considered at the end of the series.

outlier.exclfirst numeric specifying the number of periods excluded at the beginning of the series. It can be combined with outlier.exclLast.

outlier.exclLast numeric specifying the number of periods excluded at the end of the series. It can be combined with outlier.exclFirst.

outlier.ao logical. If TRUE, the automatic detection of additive outliers is enabled (outlier.enabled must also be set to TRUE).

outlier.tc logical. If TRUE, the automatic detection of transitory changes is enabled (outlier.enabled must also be set to TRUE).

outlier.ls logical. If TRUE, the automatic detection of level shifts is enabled (outlier.enabled must also be set to TRUE).

outlier.so logical. If TRUE, the automatic detection of seasonal outliers is enabled (outlier.enabled must also be set to TRUE).

outlier.usedefcv logical. If TRUE, the critical value for the outliers’ detection procedure is automatically determined by the number of observations in the outlier detection time span. If FALSE, the procedure uses the entered critical value (outlier.cv).

outlier.cv numeric. The entered critical value for the outliers’ detection procedure. The modification of this variable is only taken into account when outlier.usedefcv is set to FALSE.

outlier.eml logical for the exact likelihood estimation method. It controls the method applied for a parameter estimation in the intermediate steps of the automatic detection and correction of outliers. If TRUE, an exact likelihood estimation method is used. When FALSE, the fast Hannan-Rissanen method is used.

outlier.tcrate numeric. The rate of decay for the transitory change outlier.

automdl.enabled logical. If TRUE, the automatic modelling of the ARIMA model is enabled. If FALSE, the parameters of the ARIMA model can be specified.

Control variables for the automatic modelling of the ARIMA model (automdl.enabled is set to TRUE):

automdl.acceptdefault logical. If TRUE, the default model (ARIMA(0,1,1)(0,1,1)) may be chosen in the first step of the automatic model identification. If the Ljung-Box Q statistics for the residuals is acceptable, the default model is accepted and no further attempt will be made to identify another model.

automdl.cancel numeric, the cancelation limit. If the difference in moduli of an AR and an MA roots (when estimating ARIMA(1,0,1)(1,0,1) models in the second step of the automatic identification of the differencing orders) is smaller than the cancelation limit, the two roots are assumed equal and cancel out.

automdl.ub1 numeric, the first unit root limit. It is the threshold value for the initial unit root test in the automatic differencing procedure. When one of the roots in the estimation of the ARIMA(2,0,0)(1,0,0) plus mean model, performed in the first step of the automatic model identification procedure, is larger than first unit root limit in modulus, it is set equal to unity.
automdl.ub2 numeric, the second unit root limit. When one of the roots in the estimation of the ARIMA(1,0,1)(1,0,1) plus mean model, which is performed in the second step of the automatic model identification procedure, is larger than second unit root limit in modulus, it is checked if there is a common factor in the corresponding AR and MA polynomials of the ARMA model that can be cancelled (see automdl.cancel). If there is no cancellation, the AR root is set equal to unity (i.e. the differencing order changes).

automdl.armalimit numeric, the arma limit. It is the threshold value for t-statistics of ARMA coefficients and the constant term used for the final test of model parsimony. If the highest order ARMA coefficient has a t-value smaller than this value in magnitude, the order of the model is reduced. If the constant term has a t-value smaller than the ARMA limit in magnitude, it is removed from the set of regressors.

automdl.reducecv numeric, ReduceCV. The percentage by which the outlier critical value will be reduced when an identified model is found to have a Ljung-Box statistic with an unacceptable confidence coefficient. The parameter should be between 0 and 1, and will only be active when automatic outlier identification is enabled. The reduced critical value will be set to (1-ReduceCV)xCV, where CV is the original critical value.

automdl.ljungboxlimit numeric, the Ljung Box limit, setting the acceptance criterion for the confidence intervals of the Ljung-Box Q statistic. If the LjungBox Q statistics for the residuals of a final model is greater than Ljung Box limit, then the model is rejected, the outlier critical value is reduced, and model and outlier identification (if specified) is redone with a reduced value.

automdl.compare logical. If TRUE, the program compares the model identified by the automatic procedure to the default model (ARIMA(0,1,1)(0,1,1)) and the model with the best fit is selected. Criteria considered are residual diagnostics, the model structure and the number of outliers.

Control variables for the non-automatic modelling of the ARIMA model (automdl.enabled is set to FALSE):

arima.mu logical. If TRUE, the mean is considered as part of the ARIMA model.
arima.p numeric. The order of the non-seasonal autoregressive (AR) polynomial.
arima.d numeric. The regular differencing order.
arima.q numeric. The order of the non-seasonal moving average (MA) polynomial.
arima.bp numeric. The order of the seasonal autoregressive (AR) polynomial.
arima.bd numeric. The seasonal differencing order.
arima.bq numeric. The order of the seasonal moving average (MA) polynomial.

Control variables for the user-defined ARMA coefficients. Such coefficients can be defined for the regular and seasonal autoregressive (AR) polynomials and moving average (MA) polynomials. The model considers the coefficients only if the procedure for their estimation (arima.coefType) is provided, and the number of provided coefficients matches the sum of (regular and seasonal) AR and MA orders (p,q,bp,bq).
arima.coef
- a vector providing the coefficients for the regular and seasonal AR and MA polynomials. The length of the vector must be equal to the sum of the regular and seasonal AR and MA orders. The coefficients shall be provided in the following order: regular AR (\(\Phi_p\) elements), regular MA (\(\Theta_q\) elements), seasonal AR (\(\Phi_{bp}\) elements) and seasonal MA (\(\Theta_{bq}\) elements).

E.g.: \(\text{arima.coef} = c(0.6, 0.7)\) with \(\text{arima.p} = 1, \text{arima.q} = 0, \text{arima.bp} = 1\) and \(\text{arima.bq} = 0\).

arima.coefType
- a vector defining the ARMA coefficients estimation procedure. Possible procedures are: "Undefined" = no use of user-defined input (i.e. coefficients are estimated), "Fixed" = fixes the coefficients at the value provided by the user, "Initial" = the value defined by the user is used as initial condition. For orders for which the coefficients shall not be defined, the \text{arima.coef} can be set to NA or 0 or the \text{arima.coefType} can be set to "Undefined". E.g.: \(\text{arima.coef} = c(-0.8, -0.6, \text{NA}), \text{arima.coefType} = c(\"Fixed\", \"Fixed\", \"Undefined\")\).

fcst.horizon
- numeric, the forecasting horizon. The length of the forecasts generated by the RegARIMA model in periods (positive values) or years (negative values). By default, the program generates two years forecasts (fcst.horizon set to \(-2\)).

seats.predictionLength
- integer: the number of forecasts used in the decomposition. Negative values correspond to numbers of years.

seats.approx
- character: the approximation mode. When the ARIMA model estimated by TRAMO does not accept an admissible decomposition, SEATS: "None" - performs an approximation; "Legacy" - replaces the model with a decomposable one; "Noisy" - estimates a new model by adding a white noise to the non-admissible model estimated by TRAMO.

seats.trendBoundary
- numeric: the trend boundary. The boundary beyond which an AR root is integrated in the trend component. If the modulus of the inverse real root is greater than the trend boundary, the AR root is integrated in the trend component. Below this value, the root is integrated in the transitory component.

seats.seasdBoundary
- numeric: the seasonal boundary. The boundary beyond which a negative AR root is integrated in the seasonal component.

seats.seasdBoundary1
- numeric: the seasonal boundary (unique). The boundary beyond which a negative AR root is integrated in the seasonal component, when the root is the unique seasonal root.

seats.seasTol
- numeric: the seasonal tolerance. The tolerance (measured in degrees) to allocate the AR non-real roots to the seasonal component (if the modulus of the inverse complex AR root is greater than the trend boundary and the frequency of this root differs from one of the seasonal frequencies by less than Seasonal tolerance) or the transitory component (otherwise).

seats.maBoundary
- numeric: the MA unit root boundary. When the modulus of an estimated MA root falls in the range (xl, 1), it is set to xl.
seats.method character: the estimation method for the unobserved components. The choice can be made from:

- "Burman": the default value. May result in a significant underestimation of the components’ standard deviation, as it may become numerically unstable when some roots of the MA polynomial are near 1;
- "KalmanSmoother": it is not disturbed by the (quasi-) unit roots in MA;
- "McElroyMatrix": it has the same stability issues as the Burman’s algorithm.

Details

The available predefined 'JDemetra+' model specifications are described in the table below:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Log/level detection</th>
<th>Outliers detection</th>
<th>Calendar effects</th>
<th>ARIMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSA0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RSA1</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RSA2</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RSA3</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>automatic</td>
</tr>
<tr>
<td>RSA4</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>RSA5</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>7 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>RSAfull</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>automatic</td>
<td>automatic</td>
</tr>
</tbody>
</table>

Value

A two-elements list of class c("SA_spec", "TRAMO_SEATS"), containing: (1) an object of class c("regarima_spec", "TRAMO_SEATS") with the RegARIMA model specification, (2) an object of class c("seats_spec", "data.frame") with the SEATS algorithm specification. Each component refers to a different part of the SA model specification, mirroring the arguments of the function (for details see the function arguments in the description). Each lowest-level component (except span, pre-specified outliers, user-defined variables and pre-specified ARMA coefficients) is structured as a data frame with columns denoting different variables of the model specification and rows referring to:

- first row: the base specification, as provided within the argument spec;
- second row: user modifications as specified by the remaining arguments of the function (e.g.: arima.d);
- and third row: the final model specification.

The final specification (third row) shall include user modifications (row two) unless they were wrongly specified. The pre-specified outliers, user-defined variables and pre-specified ARMA coefficients consist of a list of Predefined (base model specification) and Final values.

- regarima an object of class c("regarima_spec", "TRAMO_SEATS"). See Value of the function regarima_spec_tramoseats.
- seats a data.frame of class c("seats_spec", "data.frame"), containing the seats variables in line with the names of the arguments variables. The final values can be also accessed with the function s_seats.
References

Info on 'JDemetra+', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/


See Also

tramoseats

Examples

myseries <- ipi_c_eu[, "FR"]
myspec1 <- tramoseats_spec(spec = c("RSAfull"))
myssa1 <- tramoseats(myseries, spec = myspec1)

# To modify a pre-specified model specification
myspec2 <- tramoseats_spec(spec = "RSAfull", tradingdays.mauto = "Unused",
                           tradingdays.option = "WorkingDays",
                           easter.type = "Standard",
                           automdl.enabled = FALSE, arima.mu = TRUE)
myssa2 <- tramoseats(myseries, spec = myspec2)

# To modify the model specification of a "SA" object
myspec3 <- tramoseats_spec(myspec1, tradingdays.mauto = "Unused",
                           tradingdays.option = "WorkingDays",
                           easter.type = "Standard", automdl.enabled = FALSE, arima.mu = TRUE)
myssa3 <- tramoseats(myseries, myspec3)

# To modify the model specification of a "SA_spec" object
myspec4 <- tramoseats_spec(myspec1, tradingdays.mauto = "Unused",
                           tradingdays.option = "WorkingDays",
                           easter.type = "Standard", automdl.enabled = FALSE, arima.mu = TRUE)
myssa4 <- tramoseats(myseries, myspec4)

# Pre-specified outliers
myspec5 <- tramoseats_spec(spec = "RSAfull",
                           usrdef.outliersEnabled = TRUE,
                           usrdef.outliersType = c("LS", "LS"),
                           usrdef.outliersDate = c("2008-10-01", "2003-01-01"),
                           usrdef.outliersCoef = c(10,-8), transform.function = "None")
s_preOut(myspec5)
myssa5 <- tramoseats(myseries, myspec5)
myssa5
s_preOut(myspec5)

# User-defined calendar regressors
var1 <- ts(rnorm(length(myseries)) * 10, start = start(myseries), frequency = 12)
var2 <- ts(rnorm(length(myseries)) * 100, start = start(myseries), frequency = 12)
user_defined_variables

Retrieve the user-defined variable names

Description

Function to retrieve the names of the additional output variables that can be defined in x13 and tramoseats with the parameter userdefined.

Usage

user_defined_variables(sa_object = c("X13-ARIMA", "TRAMO-SEATS"))

Arguments

sa_object a character: "X13-ARIMA" to retrieve the additional output variables available for the X13-ARIMA method and "TRAMO-SEATS" for the TRAMO-SEATS method.

Examples

user_defined_variables("X13-ARIMA")
user_defined_variables("TRAMO-SEATS")
Description

Functions to estimate the seasonally adjusted series (sa) with the X13-ARIMA method. This is achieved by decomposing the time series (y) into the trend-cycle (t), the seasonal component (s) and the irregular component (i). The final seasonally adjusted series shall be free of seasonal and calendar-related movements. x13 returns a preformatted result while jx13 returns the Java objects resulting from the seasonal adjustment.

Usage

jx13(
  series,
  spec = c("RSA5c", "RSA0", "RSA1", "RSA2c", "RSA3", "RSA4c", "X11"),
  userdefined = NULL
)

x13(
  series,
  spec = c("RSA5c", "RSA0", "RSA1", "RSA2c", "RSA3", "RSA4c", "X11"),
  userdefined = NULL
)

Arguments

- **series**: a univariate time series
- **spec**: the x13 model specification. It can be the name (character) of a pre-defined X13 'JDemetra+' model specification (see Details) or of a specification created with the x13_spec function. The default value is "RSA5c".
- **userdefined**: a character vector containing the additional output variables (see user_defined_variables).

Details

The first step of a seasonal adjustment consist in pre-adjusting the time series. This is done by removing its deterministic effects, using a regression model with ARIMA noise (RegARIMA, see: regarima). In the second part, the pre-adjusted series is decomposed into the following components: trend-cycle (t), seasonal component (s) and irregular component (i). The decomposition can be: additive \( y = t + s + i \) or multiplicative \( y = t \times s \times i \). The final seasonally adjusted series (sa) shall be free of seasonal and calendar-related movements.

In the X13 method, the X11 algorithm (second step) decomposes the time series by means of linear filters. More information on the method can be found on the U.S. Census Bureau website.

The available pre-defined 'JDemetra+' X13 model specifications are described in the table below:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Log/level detection</th>
<th>Outliers detection</th>
<th>Calendar effects</th>
<th>ARIMA</th>
</tr>
</thead>
</table>

---

x13
\begin{verbatim}
RSA0 |  NA |  NA |  NA | Airline(+mean)
RSA1 | automatic | AO/LS/TC | NA | Airline(+mean)
RSA2c | automatic | AO/LS/TC | 2 td vars + Easter | Airline(+mean)
RSA3 | automatic | AO/LS/TC | NA | automatic
RSA4c | automatic | AO/LS/TC | 2 td vars + Easter | automatic
RSA5c | automatic | AO/LS/TC | 7 td vars + Easter | automatic
X11 |  NA |  NA |  NA | NA
\end{verbatim}

**Value**

\texttt{x13} returns the result of the seasonal adjustment in a Java (\texttt{jSA}) object, without any formatting. Therefore, the computation is faster than with the \texttt{x13} function. The results of the seasonal adjustment can be extracted with the function \texttt{get_indicators}.

\texttt{x13} returns an object of class \texttt{c("SA","X13")}, that is, a list containing the following components:

- \texttt{regarima}: an object of class \texttt{c("regarima","X13")}. More info in the \texttt{Value} section of the function \texttt{regarima}.
- \texttt{decomposition}: an object of class \texttt{"decomposition_X11"}, that is a six-element list:
  - \texttt{specification} a list with the X11 algorithm specification. See also the function \texttt{x13_spec}.
  - \texttt{mode} the decomposition mode
  - \texttt{mstats} the matrix with the M statistics
  - \texttt{si_ratio} the time series matrix (mts) with the d8 and d10 series
  - \texttt{s_filter} the seasonal filters
  - \texttt{t_filter} the trend filter
- \texttt{final}: an object of class \texttt{c("final","mts","ts","matrix")}. The matrix contains the final results of the seasonal adjustment: the original time series (\(y\)) and its forecast (\(y_f\)), the trend (\(t\)) and its forecast (\(t_f\)), the seasonally adjusted series (\(sa\)) and its forecast (\(sa_f\)), the seasonal component (\(s\)) and its forecast (\(s_f\)), and the irregular component (\(i\)) and its forecast (\(i_f\)).
- \texttt{diagnostics}: an object of class \texttt{"diagnostics"}, that is a list containing three types of tests results:
  - \texttt{variance_decomposition} a data.frame with the tests results on the relative contribution of the components to the stationary portion of the variance in the original series, after the removal of the long term trend;
  - \texttt{residuals_test} a data.frame with the tests results of the presence of seasonality in the residuals (including the statistic test values, the corresponding p-values and the parameters description);
  - \texttt{combined_test} the combined tests for stable seasonality in the entire series. The format is a two elements list with: \texttt{tests_for_stable_seasonality}, a data.frame containing the tests results (including the statistic test value, its p-value and the parameters description), and \texttt{combined_seasonality_test}, the summary.
- \texttt{user_defined}: an object of class \texttt{"user_defined"}: a list containing the additional userdefined variables.
References

Info on 'JDemetra+', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/


See Also

x13_spec, tramoseats

Examples

myseries <- ipi_c_eu[, "FR"]
mysa <- x13(myseries, spec = "RSA5c")

myspec1 <- x13_spec(mysa, tradingdays.option = "WorkingDays",
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")
mysa1 <- x13(myseries, myspec1)
mysa1
summary(mysa1$regarima)

myspec2 <- x13_spec(mysa, automdl.enabled =FALSE,
arima.coefEnabled = TRUE,
arima.p = 1, arima.q = 1, arima.bp = 0, arima.bq = 1,
arima.coef = c(-0.8, -0.6, 0),
arima.coefType = c(rep("Fixed", 2), "Undefined"))
s_arimaCoef(myspec2)
mysa2 <- x13(myseries, myspec2,
userdefined = c("decomposition.d18", "decomposition.d19"))
mysa2
plot(mysa2)
plot(mysa2$regarima)
plot(mysa2$decomposition)
**Description**

Function to create (and/or modify) a c("SA_spec","X13") class object with the SA model specification for the X13 method. It can be done from a pre-defined 'JDemetra+' model specification (a character), a previous specification (c("SA_spec","X13") object) or a seasonal adjustment model (c("SA","X13") object).

**Usage**

```r
x13_spec(
  spec = c("RSA5c", "RSA0", "RSA1", "RSA2c", "RSA3", "RSA4c", "X11"),
  preliminary.check = NA,
  estimate.from = NA_character_,
  estimate.to = NA_character_,
  estimate.first = NA_integer_,
  estimate.last = NA_integer_,
  estimate.exclFirst = NA_integer_,
  estimate.exclLast = NA_integer_,
  estimate.tol = NA_integer_,
  transform.function = c(NA, "Auto", "None", "Log"),
  transform.adjust = c(NA, "None", "LeapYear", "LengthOfPeriod"),
  transform.aicdiff = NA_integer_,
  usrdef.outliersEnabled = NA,
  usrdef.outliersType = NA,
  usrdef.outliersDate = NA,
  usrdef.outliersCoef = NA,
  usrdef.varEnabled = NA,
  usrdef.var = NA,
  usrdef.varType = NA,
  usrdef.varCoef = NA,
  tradingdays.option = c(NA, "TradingDays", "WorkingDays", "UserDefined", "None"),
  tradingdays.autoadjust = NA,
  tradingdays.leapyear = c(NA, "LeapYear", "LengthOfPeriod", "None"),
  tradingdays.stocktd = NA_integer_,
  tradingdays.test = c(NA, "Remove", "Add", "None"),
  easter.enabled = NA,
  easter.julian = NA,
  easter.duration = NA_integer_,
  easter.test = c(NA, "Add", "Remove", "None"),
  outlier.enabled = NA,
  outlier.from = NA_character_,
  outlier.to = NA_character_,
  outlier.first = NA_integer_,
  outlier.last = NA_integer_,
  outlier.exclFirst = NA_integer_,
  outlier.exclLast = NA_integer_,
  outlier.ao = NA,
  outlier.tc = NA,
  outlier.ls = NA,
)```
Arguments

spec an x13 model specification. It can be the 'JDemetra+' name (character) of a predefined X13 'JDemetra+' model specification (see Details), an object of class c("SA_spec","X13") or an object of class c("SA","X13"). The default is "RSA5c".
preliminary.check

a boolean to check the quality of the input series and exclude highly problematic
ones (e.g. the series with a number of identical observations and/or missing
values above pre-specified threshold values).

The time span of the series to be used for the estimation of the RegARIMA
model coefficients is controlled by the following six variables: estimate.from, estimate.to, estimate
and estimate.exclLast; where estimate.from and estimate.to have priority
over the remaining span control variables, estimate.last and estimate.first
have priority over estimate.exclFirst and estimate.exclLast, and estimate.last
has priority over estimate.first.

estimate.from

a character in format "YYYY-MM-DD" indicating the start of the time span
(e.g. "1900-01-01"). It can be combined with the parameter estimate.to.

estimate.to

a character in format "YYYY-MM-DD" indicating the end of the time span (e.g.
"2020-12-31"). It can be combined with the parameter estimate.from.

estimate.first

a numeric specifying the number of periods considered at the beginning of the
series.

estimate.last

numeric specifying the number of periods considered at the end of the series.

estimate.exclFirst

a numeric specifying the number of periods excluded at the beginning of the
series. It can be combined with the parameter estimate.exclLast.

estimate.exclLast

a numeric specifying the number of periods excluded at the end of the series. It
can be combined with the parameter estimate.exclFirst.

estimate.tol

a numeric, convergence tolerance. The absolute changes in the log-likelihood
function are compared to this value to check for the convergence of the estima-
tion iterations.

transform.function

the transformation of the input series: "None" = no transformation of the series;
"Log" = takes the log of the series; "Auto" = the program tests for the log-level
specification.

transform.adjust

pre-adjustment of the input series for the length of period or leap year effects:
"None" = no adjustment; "LeapYear" = leap year effect; "LengthOfPeriod" =
length of period. Modifications of this variable are taken into account only when
transform.function is set to "Log".

transform.aicdiff

a numeric defining the difference in AICC needed to accept no transformation
when the automatic transformation selection is chosen (considered only when
transform.function is set to "Auto").

Control variables for the pre-specified outliers. The pre-specified outliers are
used in the model only when enabled (usrdef.outliersEnabled=TRUE) and
the outliers' type (usrdef.outliersType) and date (usrdef.outliersDate) are
provided.

usrdef.outliersEnabled

logical. If TRUE, the program uses the pre-specified outliers.
usrdef.outliersType
  a vector defining the outliers' type. Possible types are: ("AO") = additive, ("LS") = level shift, ("TC") = transitory change, ("SO") = seasonal outlier. E.g.: usrdef.outliersType = c("AO","AO","LS").

usrdef.outliersDate
  a vector defining the outliers' dates. The dates should be characters in format "YYYY-MM-DD". E.g.: usrdef.outliersDate = c("2009-10-01","2005-02-01","2003-04-01").

usrdef.outliersCoef
  a vector providing fixed coefficients for the outliers. The coefficients can't be fixed if transform.function is set to "Auto" i.e. the series transformation need to be pre-defined. E.g.: usrdef.outliersCoef = c(200,170,20).

usrdef.varEnabled
  a logical. If TRUE, the program uses the user-defined variables.

usrdef.var
  a time series (ts) or a matrix of time series (mts) with the user-defined variables.

usrdef.varType
  a vector of character(s) defining the user-defined variables component type. Possible types are: "Undefined","Series","Trend","Seasonal","SeasonallyAdjusted","Irregular","Calendar". The type "Calendar" must be used with tradingdays.option = "UserDefined" to use user-defined calendar regressors. If not specified, the program will assign the "Undefined" type.

usrdef.varCoef
  a vector providing fixed coefficients for the user-defined variables. The coefficients can't be fixed if transform.function is set to "Auto" i.e. the series transformation need to be pre-defined.

tradingdays.option
  to specify the set of trading days regression variables: "TradingDays" = six day-of-the-week regression variables; "WorkingDays" = one working/non-working day contrast variable; "None" = no correction for trading days and working days effects; "UserDefined" = user-defined trading days regressors (regressors must be defined by the usrdef.var argument with usrdef.varType set to "Calendar" and usrdef.varEnabled = TRUE). "None" must also be specified for the "day-of-week effects" correction (tradingdays.stocktd to be modified accordingly).

tradingdays.autoadjust
  a logical. If TRUE, the program corrects automatically for the leap year effect. Modifications of this variable are taken into account only when transform.function is set to "Auto".

tradingdays.leapyear
  a character to specify whether or not to include the leap-year effect in the model: "LeapYear" = leap year effect; "LengthOfPeriod" = length of period, "None" = no effect included. The leap-year effect can be pre-specified in the model only if the input series hasn't been pre-adjusted (transform.adjust set to "None") and if the automatic correction for the leap-year effect isn't selected (tradingdays.autoadjust set to FALSE).

tradingdays.stocktd
  a numeric indicating the day of the month when inventories and other stock are reported (to denote the last day of the month, set the variable to 31). Modifications of this variable are taken into account only when tradingdays.option is set to "None".
tradingdays.test defines the pre-tests for the significance of the trading day regression variables based on the AICC statistics: "Add" = the trading day variables are not included in the initial regression model but can be added to the RegARIMA model after the test; "Remove" = the trading day variables belong to the initial regression model but can be removed from the RegARIMA model after the test; "None" = the trading day variables are not pre-tested and are included in the model.

easter.enabled a logical. If TRUE, the program considers the Easter effect in the model.
easter.julian a logical. If TRUE, the program uses the Julian Easter (expressed in Gregorian calendar).
easter.duration a numeric indicating the duration of the Easter effect (length in days, between 1 and 20).
easter.test defines the pre-tests for the significance of the Easter effect based on the t-statistic (the Easter effect is considered as significant if the t-statistic is greater than 1.96): "Add" = the Easter effect variable is not included in the initial regression model but can be added to the RegARIMA model after the test; "Remove" = the Easter effect variable belongs to the initial regression model but can be removed from the RegARIMA model after the test; "None" = the Easter effect variable is not pre-tested and is included in the model.

outlier.enabled a logical. If TRUE, the automatic detection of outliers is enabled in the defined time span.

The time span during which outliers will be searched is controlled by the following six variables: outlier.from, outlier.to, outlier.first, outlier.last, outlier.exclFirst and outlier.exclLast; where outlier.from and outlier.to have priority over the remaining span control variables, outlier.last and outlier.first have priority over outlier.exclFirst and outlier.exclLast, and outlier.last has priority over outlier.first.

outlier.from a character in format "YYYY-MM-DD" indicating the start of the time span (e.g. "1900-01-01"). It can be combined with the parameter outlier.to.

outlier.to a character in format "YYYY-MM-DD" indicating the end of the time span (e.g. "2020-12-31"). it can be combined with the parameter outlier.from.

outlier.first a numeric specifying the number of periods considered at the beginning of the series.

outlier.last a numeric specifying the number of periods considered at the end of the series.

outlier.exclFirst a numeric specifying the number of periods excluded at the beginning of the series. It can be combined with the parameter outlier.exclLast.

outlier.exclLast a numeric specifying the number of periods excluded at the end of the series. It can be combined with the parameter outlier.exclFirst.

outlier ao a logical. If TRUE, the automatic detection of additive outliers is enabled (outlier.enabled must be also set to TRUE).

outlier.tc a logical. If TRUE, the automatic detection of transitory changes is enabled (outlier.enabled must be also set to TRUE).
outlier.ls a logical. If TRUE, the automatic detection of level shifts is enabled (outlier.enabled must be also set to TRUE).

outlier.so a logical. If TRUE, the automatic detection of seasonal outliers is enabled (outlier.enabled must be also set to TRUE).

outlier.usedefcv a logical. If TRUE, the critical value for the outlier detection procedure is automatically determined by the number of observations in the outlier detection time span. If FALSE, the procedure uses the entered critical value (outlier.cv).

outlier.cv a numeric. The entered critical value for the outlier detection procedure. The modification of this variable is only taken into account when outlier.usedefcv is set to FALSE.

outlier.method determines how the program successively adds detected outliers to the model. At present, only the AddOne method is supported.

outlier.tcrate a numeric. The rate of decay for the transitory change outlier.

automdl.enabled a logical. If TRUE, the automatic modelling of the ARIMA model is enabled. If FALSE, the parameters of the ARIMA model can be specified. Control variables for the automatic modelling of the ARIMA model (when automdl.enabled is set to TRUE):

automdl.acceptdefault a logical. If TRUE, the default model (ARIMA(0,1,1)(0,1,1)) may be chosen in the first step of the automatic model identification. If the Ljung-Box Q statistics for the residuals is acceptable, the default model is accepted and no further attempt will be made to identify another model.

automdl.cancel the cancelation limit (numeric). If the difference in moduli of an AR and an MA roots (when estimating ARIMA(1,0,1)(1,0,1) models in the second step of the automatic identification of the differencing orders) is smaller than the cancelation limit, the two roots are assumed equal and cancel out.

automdl.ub1 the first unit root limit (numeric). It is the threshold value for the initial unit root test in the automatic differencing procedure. When one of the roots in the estimation of the ARIMA(2,0,0)(1,0,0) plus mean model, performed in the first step of the automatic model identification procedure, is larger than the first unit root limit in modulus, it is set equal to unity.

automdl.ub2 the second unit root limit (numeric). When one of the roots in the estimation of the ARIMA(1,0,1)(1,0,1) plus mean model, which is performed in the second step of the automatic model identification procedure, is larger than second unit root limit in modulus, it is checked if there is a common factor in the corresponding AR and MA polynomials of the ARMA model that can be cancelled (see automdl.cancel). If there is no cancellation, the AR root is set equal to unity (i.e. the differencing order changes).

automdl.mixed a logical. This variable controls whether ARIMA models with non-seasonal AR and MA terms or seasonal AR and MA terms will be considered in the automatic model identification procedure. If FALSE, a model with AR and MA terms in both the seasonal and non-seasonal parts of the model can be acceptable, provided there are no AR or MA terms in either the seasonal or non-seasonal terms.
automdl.balanced

a logical. If TRUE, the automatic model identification procedure will have a preference for balanced models (i.e. models for which the order of the combined AR and differencing operator is equal to the order of the combined MA operator).

automdl.armalimit

the ARMA limit (numeric). It is the threshold value for t-statistics of ARMA coefficients and constant term used for the final test of model parsimony. If the highest order ARMA coefficient has a t-value smaller than this value in magnitude, the order of the model is reduced. If the constant term t-value is smaller than the ARMA limit in magnitude, it is removed from the set of regressors.

automdl.reducecv

numeric, ReduceCV. The percentage by which the outlier's critical value will be reduced when an identified model is found to have a Ljung-Box statistic with an unacceptable confidence coefficient. The parameter should be between 0 and 1, and will only be active when automatic outlier identification is enabled. The reduced critical value will be set to (1-ReduceCV)*CV, where CV is the original critical value.

automdl.ljungboxlimit

the Ljung Box limit (numeric). Acceptance criterion for the confidence intervals of the Ljung-Box Q statistic. If the LjungBox Q statistics for the residuals of a final model is greater than the Ljung Box limit, then the model is rejected, the outlier critical value is reduced and model and outlier identification (if specified) is redone with a reduced value.

automdl.ubfinal

numeric, final unit root limit. The threshold value for the final unit root test. If the magnitude of an AR root for the final model is smaller than the final unit root limit, then a unit root is assumed, the order of the AR polynomial is reduced by one and the appropriate order of the differencing (non-seasonal, seasonal) is increased. The parameter value should be greater than one.

Control variables for the non-automatic modelling of the ARIMA model (when automdl.enabled is set to FALSE):

arima.mu

logical. If TRUE, the mean is considered as part of the ARIMA model.

arima.p

numeric. The order of the non-seasonal autoregressive (AR) polynomial.

arima.d

numeric. The regular differencing order.

arima.q

numeric. The order of the non-seasonal moving average (MA) polynomial.

arima.bp

numeric. The order of the seasonal autoregressive (AR) polynomial.

arima.bd

numeric. The seasonal differencing order.

arima.bq

numeric. The order of the seasonal moving average (MA) polynomial.

Control variables for the user-defined ARMA coefficients. Coefficients can be defined for the regular and seasonal autoregressive (AR) polynomials and moving average (MA) polynomials. The model considers the coefficients only if the procedure for their estimation (arima.coefType) is provided, and the number of provided coefficients matches the sum of (regular and seasonal) AR and MA orders (p,q,bp,bq).

arima.coefEnabled

logical. If TRUE, the program uses the user-defined ARMA coefficients.
arima.coef a vector providing the coefficients for the regular and seasonal AR and MA polynomials. The vector length must be equal to the sum of the regular and seasonal AR and MA orders. The coefficients shall be provided in the following order: regular AR ($\Phi; p$ elements), regular MA ($\Theta; q$ elements), seasonal AR ($B\Phi; bp$ elements) and seasonal MA ($B\Theta; bq$ elements). E.g.: \texttt{arima.coef} = c(0.6, 0.7) with arima.p = 1, arima.q = 0, arima.bp = 1 and arima.bq = 0.

arima.coefType a vector defining the ARMA coefficients estimation procedure. Possible procedures are: "Undefined" = no use of any user-defined input (i.e. coefficients are estimated), "Fixed" = the coefficients are fixed at the value provided by the user, "Initial" = the value defined by the user is used as the initial condition. For orders for which the coefficients shall not be defined, the \texttt{arima.coef} can be set to \texttt{NA} or 0, or the \texttt{arima.coefType} can be set to "Undefined". E.g.: \texttt{arima.coef} = \texttt{c(-0.8, -0.6, NA)}, \texttt{arima.coefType} = \texttt{c("Fixed", "Fixed", "Undefined")}.

fcst.horizon the forecasting horizon (numeric). The forecast length generated by the RegARIMA model in periods (positive values) or years (negative values). By default, the program generates a two-year forecast (fcst.horizon set to -2).

x11.mode character: the decomposition mode. Determines the mode of the seasonal adjustment decomposition to be performed: "Undefined" - no assumption concerning the relationship between the time series components is made; "Additive" - assumes an additive relationship; "Multiplicative" - assumes a multiplicative relationship; "LogAdditive" - performs an additive decomposition of the logarithms of the series being adjusted; "PseudoAdditive" - assumes a pseudo-additive relationship. Could be changed by the program, if needed.

x11.seasonalComp logical: if TRUE, the program computes a seasonal component. Otherwise, the seasonal component is not estimated and its values are all set to 0 (additive decomposition) or 1 (multiplicative decomposition).

x11.lsigma numeric: the lower sigma boundary for the detection of extreme values.

x11.usigma numeric: the upper sigma boundary for the detection of extreme values.

x11.trendAuto logical: automatic Henderson filter. If TRUE, an automatic selection of the Henderson filter's length for the trend estimation is enabled.

x11.trendma numeric: the length of the Henderson filter. The user-defined length of the Henderson filter. The option is available when the automatic Henderson filter selection is disabled (x11.trendAuto = FALSE). Should be an odd number in the range (1, 101].

x11.seasonalma a vector of character(s) specifying which seasonal moving average (i.e. seasonal filter) will be used to estimate the seasonal factors for the entire series. The vector can be of length: 1 - same seasonal filters for all periods (e.g.: \texttt{seasonalma} = \texttt{c("Msr")}); or the period length - a seasonal filter is defined for each period (e.g. for quarterly series: \texttt{seasonalma} = \texttt{c("S3X3", "Msr", "S3X3", "Msr")}). Possible filters are: "Msr", "Stable", "X11Default", "S3X1", "S3X3", "S3X5", "S3X9", "S3X15". "Msr" - the program chooses the final seasonal filter automatically.

x11.fcasts numeric: the number of forecasts generated by the RegARIMA model in periods (positive values) or years (negative values).
x11.bcasts

numeric: the number of backcasts used in X11. Negative figures are translated in years of backcasts.

x11.calendarSigma

character to specify if the standard errors used for extreme values detection and adjustment are computed: from 5 year spans of irregulars ("None", the default); separately for each calendar month/quarter ("All"); separately for each period only if Cochran’s hypothesis test determines that the irregular component is heteroskedastic by calendar month/quarter ("Signif"); separately for two complementary sets of calendar months/quarters specified by the x11.sigmaVector parameter ("Select", see parameter x11.sigmaVector).

x11.sigmaVector

a vector to specify one of the two groups of periods for whose standard errors used for extreme values detection and adjustment will be computed. Only used if x11.calendarSigma = "Select". Possible values are: "Group1" and "Group2".

x11.excludeFcasts

logical: to exclude forecasts and backcasts. If TRUE, the RegARIMA model forecasts and backcasts are not used during the detection of extreme values in the seasonal adjustment routines.

Details

The available predefined 'JDemetra+' model specifications are described in the table below:

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Log/level detection</th>
<th>Outliers detection</th>
<th>Calendar effects</th>
<th>ARIMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSA0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RSA1</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RSA2c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>Airline(+mean)</td>
</tr>
<tr>
<td>RSA3</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>NA</td>
<td>automatic</td>
</tr>
<tr>
<td>RSA4c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>2 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>RSA5c</td>
<td>automatic</td>
<td>AO/LS/TC</td>
<td>7 td vars + Easter</td>
<td>automatic</td>
</tr>
<tr>
<td>X11</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Value

A two-elements list of class c("SA_spec","X13"). containing: (1) an object of class c("regarima_spec","X13") with the RegARIMA model specification; (2) an object of class c("X11_spec","data.frame") with the X11 algorithm specification. Each component refers to different parts of the SA model specification, mirroring the arguments of the function (for details, see the function arguments in the description). Each lowest-level component (except span, pre-specified outliers, user-defined variables and pre-specified ARMA coefficients) is structured as a data frame with columns denoting different variables of the model specification and rows referring to:

- first row: the base specification, as provided within the argument spec;
- second row: user modifications as specified by the remaining arguments of the function (e.g.: arima.d);
- and third row: the final model specification.
The final specification (third row) shall include user modifications (row two) unless they were wrongly specified. The pre-specified outliers, user-defined variables and pre-specified ARMA coefficients consist of a list of Predefined (base model specification) and Final values.

- regarimaan object of class c("regarima_spec","x13"). See Value of the function regarima_spec_x13.
- x11a data.frame of class c("X11_spec","data.frame"), containing the x11 variables in line with the names of the arguments variables. The final values can be also accessed with the function s_x11.

References

Info on 'JDemetra-', usage and functions: https://ec.europa.eu/eurostat/cros/content/documentation_en/


See Also

x13

Examples

```r
myseries <- ipe_c_eu[, "FR"]
myspec1 <- x13_spec(spec = "RSA5c")
myreg1 <- x13(myseries, spec = myspec1)

# To modify a pre-specified model specification
myspec2 <- x13_spec(spec = "RSA5c", tradingdays.option = "WorkingDays")
myreg2 <- x13(myseries, spec = myspec2)

# To modify the model specification of a "X13" object
myspec3 <- x13_spec(myreg1, tradingdays.option = "WorkingDays")
myreg3 <- x13(myseries, myspec3)

# To modify the model specification of a "X13_spec" object
myspec4 <- x13_spec(myspec1, tradingdays.option = "WorkingDays")
myreg4 <- x13(myseries, myspec4)

# Pre-specified outliers
myspec1 <- x13_spec(spec = "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")

myreg1 <- x13(myseries, myspec1)
myreg1
s_preOut(myreg1)
```
# User-defined calendar regressors
var1 <- ts(rnorm(length(myseries))*10, start = start(myseries), frequency = 12)
var2 <- ts(rnorm(length(myseries))*100, start = start(myseries), frequency = 12)
var <- ts.union(var1, var2)

myspec1 <- x13_spec(spec = "RSA5c", tradingdays.option = "UserDefined",
                     usrdef.varEnabled = TRUE,
                     usrdef.var = var,
                     usrdef.varType = c("Calendar", "Calendar"))

myreg1 <- x13(myseries, myspec1)

myspec2 <- x13_spec(spec = "RSA5c", usrdef.varEnabled = TRUE,
                     usrdef.var = var1, usrdef.varCoef = 2,
                     transform.function = "None")

myreg2 <- x13(myseries, myspec2)
s_preVar(myreg2)

# Pre-specified ARMA coefficients

myspec1 <- x13_spec(spec = "RSA5c", automdl.enabled = FALSE,
                     arima.p = 1, arima.q = 1, arima.bp = 0, arima.bq = 1,
                     arima.coefEnabled = TRUE,
                     arima.coef = c(-0.8, -0.6, 0),
                     arima.coefType = c(rep("Fixed", 2), "Undefined"))

s_arimaCoef(myspec1)

myreg1 <- x13(myseries, myspec1)

myreg1

# To define a seasonal filter

myspec1 <- x13_spec("RSA5c", x11.seasonalma = rep("S3X1", 12))

mysa1 <- x13(myseries, myspec1)
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