Package 'RJDemetra'

April 27, 2023

Type Package

Title Interface to 'JDemetra+' Seasonal Adjustment Software

Version 0.2.2

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 (>= 8)

License EUPL

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

LazyData TRUE

Suggests knitr, rmarkdown

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

Encoding UTF-8

RoxygenNote 7.2.3

NeedsCompilation no

Author Alain Quartier-la-Tente [aut, cre]
(<https://orcid.org/0000-0001-7890-3857>),
Anna Michalek [aut],
Jean Palate [aut],
Raf Baeyens [aut]

Maintainer Alain Quartier-la-Tente <alain.quartier@yahoo.fr>

Repository CRAN

Date/Publication 2023-04-27 08:33:17 UTC

R topics documented:

`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.

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 multiprocessings 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 multiprocessings are computed.

See Also

get_model

Examples

```
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

```
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

```
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

```
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

```
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`.

Examples

```
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")

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 "sa1"

# 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

```
get_object(x, pos = 1)

get_all_objects(x)
```

Arguments

x	the object in which to store the extracted multiprocessing or sa_item.
pos	the index of the object to extract.

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 information 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.

See Also

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

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")
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)
```

---

ipi_c_eu — *Industrial Production Indices in manufacturing industry in the European Union*

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

```
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	Czech Republic
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

Eurostat, 'sts_inpr_m' database.

`jSA` *Functions around 'jSA' objects*

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".

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 indicators 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
jSA2R(mysa)
```

---

load_workspace *Load a 'JDemetra+' 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 *Create a workspace or a multi-processing*

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(
  x,
  first_date,
  last_date,
  forecast = TRUE,
  type_chart = c("sa-trend", "cal-seas-irr"),
  caption = c(`sa-trend` = "Y, Sa, trend", `cal-seas-irr` =
    "Cal., sea., irr.")[type_chart],
  ask = length(type_chart) > 1 && dev.interactive(),
  ylim,
  ...
)

## S3 method for class 'SA'
plot(x, ...)
```

Arguments

`x`	the object to plot
`which`	a numeric vector specifying which graphs should be plotted: (1) "Residuals", (2) "Histogram of residuals", (3) "Normal Q-Q", (4) "ACF of residuals", (5) "PACF of residuals", (6) "Decomposition", (7) "Decomposition - zoom"
`caption`	a string containing the graph title
`ask`	a Boolean. If `TRUE`, the user will be prompted before a new graphical page is started.
`...`	other parameters
`first_date`	the plot starting date. If missing, the plot starts at the beginning of the time-series.
`last_date`	the end date of the plot. If missing, the plot ends at the end of the time-series (eventually, including forecast).
`ylim`	the y limits of the plot.
`forecast`	a Boolean indicating if forecasts should be included in the plot. If `TRUE`, the forecast is plotted.
`type_chart`	a string indicating which type of chart to plot

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$decomposition) # To plot the S-I ratio
plot(mysa$decomposition, first_date = c(2010, 1)) # To start the plot in January 2010

  # Final
plot(mysa$final) # 2 graphics are plotted by default
# To only plot one graphic (here the raw data, the seasonally adjusted data and the trend),
# To change the last date and the title
plot(mysa$final, last_date = c(2000, 1),
     caption = "Results", type_chart = "sa-trend")
```

---

regarima *RegARIMA model, pre-adjustment in X13 and TRAMO-SEATS*

Description

The `regarima/regarima_x13/regarima_tramoseats` functions remove deterministic effects from the input series (e.g.calendar effects, outliers) using a multivariate regression model with arima errors. The `jregarima/jregarima_x13/jregarima_tramoseats` functions do the same computation but return the Java objects instead of a formatted output.

Usage

```
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` an 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`.
- `regarima_x13`: the name of a predefined X13 'JDemetra+' model specification (see *Details*). The default value is "RG5c".
- `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;
- $\beta = (\beta_1, ..., \beta_n)$ is a vector of regression coefficients;
- $y_t = (y_{1t}, ..., y_{nt})$ 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:

$$\phi(B) = \phi_p(B)\Phi_{bp}(B^s) = (1 + \phi_1 B + ... + \phi_p B^p)(1 + \Phi_1 B^s + ... + \Phi_{bp} B^{bps})$$

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:

$$\theta(B) = \theta_q(B)\Theta_{bq}(B^s) = (1 + \theta_1 B + ... + \theta_q B^q)(1 + \Theta_1 B^s + ... + \Theta_{bq} B^{bqs})$$

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:

Identifier	**Log/level detection**	**Outliers detection**	**Calendar effects**	**ARIMA**
RG0	*NA*	*NA*	*NA*	Airline(+mean)
RG1	automatic	AO/LS/TC	*NA*	Airline(+mean)
RG2c	automatic	AO/LS/TC	2 td vars + Easter	Airline(+mean)
RG3	automatic	AO/LS/TC	*NA*	automatic
RG4c	automatic	AO/LS/TC	2 td vars + Easter	automatic
RG5c	automatic	AO/LS/TC	7 td vars + Easter	automatic

TRAMO-SEATS:

Identifier	**Log/level detection**	**Outliers detection**	**Calendar effects**	**ARIMA**
TR0	*NA*	*NA*	*NA*	Airline(+mean)
TR1	automatic	AO/LS/TC	*NA*	Airline(+mean)
TR2	automatic	AO/LS/TC	2 td vars + Easter	Airline(+mean)
TR3	automatic	AO/LS/TC	*NA*	automatic
TR4	automatic	AO/LS/TC	2 td vars + Easter	automatic
TR5	automatic	AO/LS/TC	7 td vars + Easter	automatic
TRfull	automatic	AO/LS/TC	automatic	automatic

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

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

BOX G.E.P. and JENKINS G.M. (1970), "Time Series Analysis: Forecasting and Control", Holden-Day, San Francisco.

BOX G.E.P., JENKINS G.M., REINSEL G.C. and LJUNG G.M. (2015), "Time Series Analysis: Forecasting and Control", John Wiley & Sons, Hoboken, N. J., 5th edition.

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"),
             usrdef.outliersCoef = c(36, 14),
             transform.function = "None")
myreg2 <- regarima(myseries, myspec2)
myreg2

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)
myreg

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_spec_tramoseats

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,
```

```
    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,
    fcst.horizon = NA_integer_
  )
```

Arguments

`spec` the model specification. It can be the name (`character`) of a predefined 'JDemetra+' 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, which is the (sub)period used to estimate the regarima model, 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. Default= "All".

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
: 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 FASLE, 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
: 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. 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
: 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 in to 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 cancellation 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 cancellation limit, the two roots are assumed equal and cancelled 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.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 (*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
: avector 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 `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
: `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:

Identifier	Log/level detection	Outliers detection	Calendar effects	ARIMA
TR0	*NA*	*NA*	*NA*	Airline(+mean)
TR1	automatic	AO/LS/TC	*NA*	Airline(+mean)
TR2	automatic	AO/LS/TC	2 td vars + Easter	Airline(+mean)
TR3	automatic	AO/LS/TC	*NA*	automatic
TR4	automatic	AO/LS/TC	2 td vars + Easter	automatic
TR5	automatic	AO/LS/TC	7 td vars + Easter	automatic
TRfull	automatic	AO/LS/TC	automatic	automatic

Value

A list of class `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 `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, 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 with the `Predefined` (base model specification) and `Final` values.

- estimatea data frame containing Variables referring to: `span` - time span to be used for the estimation, `tolerance` - argument `estimate.tol`, `exact_ml` - argument `estimate.eml`, `urfinal` - argument `esimate.urfinal`. The final values can be also accessed with the function `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 matrices 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 matrices 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

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

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",
             usrdef.varEnabled = TRUE,
             usrdef.var = var, usrdef.varCoef = c(17,-1),
             transform.function = "None")
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

```
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,
  fcst.horizon = NA_integer_
)
```

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, which is the (sub)period used to estimate the regarima model, 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. Default= "All".

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 outlier 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 outlier 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 outlier 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 paramter 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 cancellation 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 cancellation 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 polynominals. 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:

Identifier |	Log/level detection |	Outliers detection |	Calendar effects |	ARIMA
RG0 |	*NA* |	*NA* |	*NA* |	Airline(+mean)
RG1 |	automatic |	AO/LS/TC |	*NA* |	Airline(+mean)
RG2c |	automatic |	AO/LS/TC |	2 td vars + Easter |	Airline(+mean)
RG3 |	automatic |	AO/LS/TC |	*NA* |	automatic
RG4c |	automatic |	AO/LS/TC |	2 td vars + Easter |	automatic
RG5c |	automatic |	AO/LS/TC |	7 td vars + Easter |	automatic

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_usrdef; outliers - matrices 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 outlier 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 matrices 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 matrices 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 automdl.enabled and all remaining variables (automdl.acceptdefault, automdl.cancel, automdl.ub1, automdl.ub2, automdl.mixed,automdl.balanced, automdl.armalimit, automdl.reducecv, automdl.ljungboxlimit, automdl.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 outlier 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

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

Examples

```
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

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","TRAM 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

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

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")
mysa6 <- x13(myseries, myspec6)

myspec7 <- tramoseats_spec("RSAfull")
mysa7 <- 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(mysa6, file.path(dir,"sax13.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(mysa7, 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"))
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 *Save a 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"))
```

---

specification *Access a model specification, a SA or a pre-adjustment model in X13 and TRAMO-SEATS*

Description

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

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

Examples

```
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)

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(mysa6)
```

---

tramoseats *Seasonal Adjustment with TRAMO-SEATS*

Description

Functions 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), the seasonal component (s) and the irregular component (i). Calendar-related movements can be corrected in the pre-treatment (TRAMO) step. `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`	an 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 consists in pre-adjusting the time series with TRAMO. This is done by removing its deterministic effects (calendar and outliers), using a regression model with ARIMA noise (RegARIMA, see: `regarima`). In the second part, the pre-adjusted series is decomposed by the SEATS algorithm 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 ($y = t * s * i$, in the latter case pre-adjustment and decomposition are performed on ($log(y) = log(t) + log(s) + log(i)$).

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 this method at https://jdemetra-new-documentation.netlify.app/m-seats-decomposition.

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

Identifier |	Log/level detection |	Outliers detection |	Calendar effects |	ARIMA
RSA0 |	*NA* |	*NA* |	*NA* |	Airline(+mean)
RSA1 |	automatic |	AO/LS/TC |	*NA* |	Airline(+mean)
RSA2 |	automatic |	AO/LS/TC |	2 td vars + Easter |	Airline(+mean)
RSA3 |	automatic |	AO/LS/TC |	*NA* |	automatic
RSA4 |	automatic |	AO/LS/TC |	2 td vars + Easter |	automatic
RSA5 |	automatic |	AO/LS/TC |	7 td vars + Easter |	automatic
RSAfull |	automatic |	AO/LS/TC |	automatic |	automatic

Value

`jtramoseats` 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-element 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

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

BOX G.E.P. and JENKINS G.M. (1970), "Time Series Analysis: Forecasting and Control", Holden-Day, San Francisco.

BOX G.E.P., JENKINS G.M., REINSEL G.C. and LJUNG G.M. (2015), "Time Series Analysis: Forecasting and Control", John Wiley & Sons, Hoboken, N. J., 5th edition.

See Also

`tramoseats_spec`, `x13`

Examples

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

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

#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)
```

```
mysa2 <- tramoseats(myseries, myspec2,
                    userdefined = c("decomposition.sa_lin_f",
                                    "decomposition.sa_lin_e"))
mysa2
plot(mysa2)
plot(mysa2$regarima)
plot(mysa2$decomposition)
```

---

tramoseats_spec *TRAMO-SEATS model specification*

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 'JDemetra+' model specification (a `character`), a previous specification (`c("SA_spec", "TRAMO_SEATS")` object) or a seasonal adjustment model (`c("SA", "TRAMO_SEATS")` object).

Usage

```
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_,
 easter.test = NA,
 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,
 fcst.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, which is the (sub)period used to estimate the regarima model, 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`. Default= "All".

`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` `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 `FASLE`, 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 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. 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
: 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 in to 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 cancellation 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 cancellation limit, the two roots are assumed equal and cancelled 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.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 (*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 avector 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 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 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 number of years. Default=-1.

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. Default="Legacy".

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. Possible values [0,1]. Default=0.5.

seats.seasdBoundary
numeric: the seasonal boundary. The boundary beyond which a negative AR root is integrated in the seasonal component. If the modulus of the inverse negative real root is greater (or equal) than Seasonal boundary, the AR root is in-

tegrated into the seasonal component. Otherwise the root is integrated into the trend or transitory component. Possible values [0,1]. Default=0.8.

`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. If the modulus of the inverse negative real root is greater (or equal) than Seasonal boundary, the AR root is integrated into the seasonal component. Otherwise the root is integrated into the trend or transitory component. Possible values [0,1]. Default=0.8.

`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). Possible values in [0,10]. Default value 2.

`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. Possible values [0.9,1]. Default=0.95.

`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:

Identifier |	Log/level detection |	Outliers detection |	Calendar effects |	ARIMA
RSA0 |	*NA* |	*NA* |	*NA* |	Airline(+mean)
RSA1 |	automatic |	AO/LS/TC |	*NA* |	Airline(+mean)
RSA2 |	automatic |	AO/LS/TC |	2 td vars + Easter |	Airline(+mean)
RSA3 |	automatic |	AO/LS/TC |	*NA* |	automatic
RSA4 |	automatic |	AO/LS/TC |	2 td vars + Easter |	automatic
RSA5 |	automatic |	AO/LS/TC |	7 td vars + Easter |	automatic
RSAfull |	automatic |	AO/LS/TC |	automatic |	automatic

Value

A two-element 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.
- regarimaan object of class `c("regarima_spec", "TRAMO_SEATS")`. See *Value* of the function `regarima_spec_tramoseats`.
- seatsa 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 also be accessed with the function `s_seats`.

References

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

See Also

`tramoseats`

Examples

```
myseries <- ipi_c_eu[, "FR"]
myspec1 <- tramoseats_spec(spec = c("RSAfull"))
mysa1 <- 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)
mysa2 <- tramoseats(myseries, spec = myspec2)

# To modify the model specification of a "SA" object
myspec3 <- tramoseats_spec(mysa1, tradingdays.mauto = "Unused",
                           tradingdays.option = "WorkingDays",
                      easter.type = "Standard", automdl.enabled = FALSE, arima.mu = TRUE)
mysa3 <- 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)
```

```
mysa4 <- 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)
mysa5 <- tramoseats(myseries, myspec5)
mysa5
s_preOut(mysa5)

# 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)

myspec6 <- tramoseats_spec(spec = "RSAfull", tradingdays.option = "UserDefined",
                           usrdef.varEnabled = TRUE, usrdef.var = var,
                           usrdef.varType = c("Calendar", "Calendar"))
s_preVar(myspec6)
mysa6 <- tramoseats(myseries, myspec6)

myspec7 <- tramoseats_spec(spec = "RSAfull", usrdef.varEnabled = TRUE,
                           usrdef.var = var, usrdef.varCoef = c(17,-1),
                           transform.function = "None")
mysa7 <- tramoseats(myseries, myspec7)

# Pre-specified ARMA coefficients
myspec8 <- tramoseats_spec(spec = "RSAfull",
                           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))
mysa8 <- tramoseats(myseries, myspec8)
mysa8
s_arimaCoef(myspec8)
s_arimaCoef(mysa8)
```

`user_defined_variables` *Display a list of all the available output objects (series, parameters, diagnostics)*

Description

Function generating a comprehensive list of available output variables (series, parameters, diagnostics) from the estimation process with x13 and tramoseats. Some items are available in the default estimation output but the remainder can be added using the `userdefined` parameter.

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.

Value

a vector containing the names of all the available output objects (series, diagnostics, parameters)

References

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

Examples

```
y<- ipi_c_eu[, "FR"]
user_defined_variables("X13-ARIMA")
m <- x13(y,"RSA5c", userdefined=c("b20","ycal","residuals.kurtosis" ))
m$user_defined$b20
m$user_defined$ycal
m$user_defined$residuals.kurtosis
user_defined_variables("TRAMO-SEATS")
m <- tramoseats(y,"RSAfull", userdefined=c("ycal","variancedecomposition.seasonality"))
m$user_defined$ycal
m$user_defined$variancedecomposition.seasonality
```

`x13` *Seasonal Adjustment with X13-ARIMA*

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). Calendar-related movements can be corrected in the pre-treatment (regarima) step. `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`	an 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 consists in pre-adjusting the time series. This is done by removing its deterministic effects (calendar and outliers), using a regression model with ARIMA noise (RegARIMA, see: `regarima`). In the second part, the pre-adjusted series is decomposed by the X11 algorithm 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 ($y = t * s * i$). More information on the X11 algorithm at https://jdemetra-new-documentation.netlify.app/m-x11-decomposition.

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

Identifier |	Log/level detection |	Outliers detection |	Calendar effects |	ARIMA
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

Value

`jx13` returns the result of the seasonal adjustment in a Java (`jSA`) object, without any formatting. Therefore, the computation is faster than with the `x13` function. The results of the seasonal adjustment can be extracted with the function `get_indicators`.

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

regarima — an object of class c("regarima","X13"). More info in the *Value* section of the function regarima.

decomposition — an object of class "decomposition_X11", that is a six-element list:

- specification a list with the X11 algorithm specification. See also the function x13_spec.
- mode the decomposition mode
- mstats the matrix with the M statistics
- si_ratio the time series matrix (mts) with the d8 and d10 series
- s_filter the seasonal filters
- t_filter the trend filter

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

More information and examples related to 'JDemetra+' features in the online documentation: https://jdemetra-new-documentation.netlify.app/

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)
```

---

x13_spec *X-13ARIMA model specification, SA/X13*

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

```
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,
 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,
    fcst.horizon = NA_integer_,
    x11.mode = c(NA, "Undefined", "Additive", "Multiplicative", "LogAdditive",
      "PseudoAdditive"),
    x11.seasonalComp = NA,
    x11.lsigma = NA_integer_,
    x11.usigma = NA_integer_,
    x11.trendAuto = NA,
    x11.trendma = NA_integer_,
    x11.seasonalma = NA_character_,
    x11.fcasts = NA_integer_,
    x11.bcasts = NA_integer_,
    x11.calendarSigma = NA,
    x11.sigmaVector = NA,
    x11.excludeFcasts = 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, which is the (sub)period used to estimate the regarima model, 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`. Default= "All".

`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 outlier 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 outlier 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 outlier 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 paramter 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 cancellation 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 cancellation 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 polynominals. 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`).

`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 an 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, > 0.5, default=1.5.

x11.usigma
: numeric: the upper sigma boundary for the detection of extreme values, > lsigma, default=2.5.

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 - the same seasonal filter is used for all periods (e.g.: ‘seasonal.filter = "Msr"‘ or ‘seasonal.filter = "S3X3"‘); or have a different value for each quarter (length 4) or each month (length 12) - (e.g. for quarterly series: ‘seasonal.filter = 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).Default value: fcasts=-1.

x11.bcasts
: numeric: the number of backcasts used in X11. Negative figures are translated in years of backcasts. Default value: bcasts=0.

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:

Identifier |	Log/level detection |	Outliers detection |	Calendar effects |	ARIMA
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

Value

A two-element 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

More information and examples related to 'JDemetra+' features in the online documentation: `https://jdemetra-new-documentation.netlify.app/` BOX G.E.P. and JENKINS G.M. (1970), "Time Series Analysis: Forecasting and Control", Holden-Day, San Francisco.

BOX G.E.P., JENKINS G.M., REINSEL G.C. and LJUNG G.M. (2015), "Time Series Analysis: Forecasting and Control", John Wiley & Sons, Hoboken, N. J., 5th edition.

See Also

x13

Examples

```
myseries <- ipi_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)
 myreg1

 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)
```

Index