Package 'tsbox'

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Type Package

Title Class-Agnostic Time Series

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Description Time series toolkit with identical behavior for all time series classes: 'ts','xts', 'data.frame', 'data.table', 'tibble', 'zoo', 'timeSeries', 'tsibble'. Also converts reliably between these classes.

Imports data.table, anytime

Suggests testthat, dplyr, tibble, forecast, seasonal, dygraphs, xts, ggplot2, scales, knitr, rmarkdown, tsibble, tibbletime, zoo, timeSeries, nycflights13

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URL https://www.tsbox.help

BugReports https://github.com/christophsax/tsbox/issues

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R topics documented:

`copy_class` *Re-Class ts-Boxable Object*

Description

Copies class attributes from an existing ts-boxable series. Mainly used internally.

Usage

```
copy_class(x, template, preserve.mode = TRUE, preserve.names = FALSE,
  preserve.time = FALSE)
```

Arguments

`x`	ts-boxable time series, an object of class `ts`, `xts`, `zoo`, `data.frame`, `data.table`, `tbl`, `tbl_ts`, `tbl_time`, or `timeSeries`.
`template`	ts-boxable time series, an object of class `ts`, `xts`, `data.frame`, `data.table`, or `tibble`. Template.
`preserve.mode`	should the mode the time column be preserved (data frame only)
`preserve.names`	should the name of the time column be preserved (data frame only)
`preserve.time`	should the values time column be preserved (data frame only)

Details

Inspired by `xts::reclass`, which does something similar.

relevant_class *Extract Relevant Class*

Description

Mainly used internally.

Usage

```
relevant_class(x)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.

Examples

```
relevant_class(AirPassengers)
relevant_class(ts_df(AirPassengers))
```

ts_ *Constructing ts-Functions*

Description

ts_ turns an existing function into a function that can deal with ts-boxable time series objects.

Usage

```
load_suggested(pkg)

ts_(fun, class = "ts", vectorize = FALSE, reclass = TRUE)

ts_apply(x, fun, ...)
```

Arguments

pkg	external package, to be suggested (automatically added by ts_) predict(). (See examples)
fun	function, to be made available to all time series classes
class	class that the function uses as its first argument
vectorize	should the function be vectorized? (not yet implemented)
reclass	logical, should the new function return the same same ts-boxable output as imputed?
x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.
...	arguments passed to subfunction

Details

The `ts_` function is a constructor function for tsbox time series functions. It can be used to wrap any function that works with time series. The default is set to R base `"ts"` class. `ts_` deals with the conversion stuff, 'vectorizes' the function so that it can be used with multiple time series.

Value

A function that accepts ts-boxable time series as an input.

See Also

ts_examples, for a few useful examples of functions generated by `ts_`.

Examples

```
ts_(rowSums)(ts_c(mdeaths, fdeaths))
ts_plot(mean = ts_(rowMeans)(ts_c(mdeaths, fdeaths)), mdeaths, fdeaths)
ts_(function(x) predict(prcomp(x)))(ts_c(mdeaths, fdeaths))
ts_(function(x) predict(prcomp(x, scale = TRUE)))(ts_c(mdeaths, fdeaths))
ts_(dygraphs::dygraph, class = "xts")

# attach series to serach path
ts_attach <- ts_(attach, class = "tslist", reclass = FALSE)
ts_attach(EuStockMarkets)
ts_plot(DAX, SMI)
detach()
```

`ts_arithmetic` *Arithmetic Operators for ts-boxable objects*

Description

Arithmetic Operators for ts-boxable objects

Usage

```
e1 %ts+% e2

e1 %ts-% e2

e1 %ts*% e2

e1 %ts/% e2
```

Arguments

`e1`	ts-boxable time series, an object of class `ts`, `xts`, `data.frame`, `data.table`, or `tibble`.
`e2`	ts-boxable time series, an object of class `ts`, `xts`, `data.frame`, `data.table`, or `tibble`.

Value

a ts-boxable time series, with the same class as the left input.

Examples

```
head(fdeaths - mdeaths)
head(fdeaths %ts-% mdeaths)
head(ts_df(fdeaths) %ts-% mdeaths)
```

---

ts_bind *Bind Time Series*

Description

Combine time series to a new, single time series. `ts_bind` combines time series as they are, `ts_chain` chains them together, using percentage change rates.

Usage

```
ts_bind(...)

ts_chain(...)
```

Arguments

`...`	ts-boxable time series, objects of class `ts`, `xts`, `data.frame`, `data.table`, or `tibble`. Or a numeric vector (see examples).

Value

A ts-boxable object of the same class as the input. If series of different classes are combined, the class of the first series is used (if possible).

See Also

ts_c to collect multiple time series

Examples

```
ts_bind(ts_span(mdeaths, end = "1975-12-01"), fdeaths)
ts_bind(mdeaths, c(2, 2))
ts_bind(mdeaths, 3, ts_bind(fdeaths, c(99, 2)))
ts_bind(ts_dt(mdeaths), AirPassengers)

# numeric vectors
ts_bind(12, AirPassengers, c(2, 3))

ts_chain(ts_span(mdeaths, end = "1975-12-01"), fdeaths)

ts_plot(ts_pc(ts_c(
  comb = ts_chain(ts_span(mdeaths, end = "1975-12-01"), fdeaths),
  fdeaths
)))
```

ts_boxable *Test if an Object is ts-Boxable*

Description

Mainly used internally.

Usage

```
ts_boxable(x)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.

Value

logical, either TRUE or FALSE

Examples

```
ts_boxable(AirPassengers)
ts_boxable(lm)
```

ts_c *Collect Time Series*

Description

Collect time series as multiple time series.

Usage

```
ts_c(...)
```

Arguments

...	ts-boxable time series, objects of class ts, xts, data.frame, data.table, or tibble.

Details

In data frame objects, multiple time series are stored in a long data frame. In ts and xts objects, time series are combined horizontally.

Value

a ts-boxable object of the same class as the input. If series of different classes are combined, the class of the first series is used (if possible).

See Also

ts_bind, to bind multiple time series to a single series.

Examples

```
head(ts_c(ts_df(EuStockMarkets), AirPassengers))

# labeling
x <- ts_c(
  `International Airline Passengers` = ts_xts(AirPassengers),
  `Deaths from Lung Diseases` = ldeaths
)
head(x)
```

---

ts_dts *Internal Time Series Class*

Description

Internal Time Series Class

Usage

```
ts_dts(x)
```

Arguments

x	ts-boxable time series, an object of class `ts`, `xts`, `zoo`, `data.frame`, `data.table`, `tbl`, `tbl_ts`, `tbl_time`, or `timeSeries`.

---

ts_examples *Principal Components, Dygraphs, Forecasts, Seasonal Adjustment*

Description

Example Functions, Generated by ts_. `ts_prcomp` calculates the principal components of multiple time series, `ts_dygraphs` generates an interactive graphical visualization, `ts_forecast` return an univariate forecast, `ts_seas` the seasonally adjusted series.

Usage

```
ts_prcomp(x, ...)

ts_dygraphs(x, ...)

ts_forecast(x, ...)

ts_seas(x, ...)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.
...	further arguments, passed to the underlying function. For help, consider these functions, e.g., stats::prcomp.

Details

With the exception of ts_prcomp, these functions depend on external packages.

Value

Usually, a ts-boxable time series, with the same class as the input. ts_dygraphs draws a plot.

Examples

```
ts_plot(
  ts_scale(ts_c(
    Male = mdeaths,
    Female = fdeaths,
    `First principal compenent` = -ts_prcomp(ts_c(mdeaths, fdeaths))[, 1]
  )),
  title = "Deaths from lung diseases",
  subtitle = "Normalized values"
)

ts_plot(ts_c(
  male = mdeaths, female = fdeaths,
  ts_forecast(ts_c(`male (fct)` = mdeaths,  `female (fct)` = fdeaths))),
  title = "Deaths from lung diseases",
  subtitle = "Exponential smoothing forecast"
)

ts_plot(
  `Raw series` = AirPassengers,
  `Adjusted series` = ts_seas(AirPassengers),
  title = "Airline passengers",
  subtitle = "X-13 seasonal adjustment"
)


ts_dygraphs(ts_c(mdeaths, EuStockMarkets))
```

---

ts_frequency *Change Frequency*

Description

Changes the frequency of a time series. By default, incomplete periods of regular series are omitted.

Usage

```
ts_frequency(x, to = "year", aggregate = "mean", na.rm = FALSE)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.
to	desired frequency, either a character string ("year", "quarter", "month") or an integer (1, 4, 12).
aggregate	character string, or function. Either "mean", "sum", "first", or "last", or any aggregate function, such as base::mean().
na.rm	logical, if TRUE, incomplete periods are aggregated as well. For irregular series, incomplete periods are always aggregated.

Value

a ts-boxable time series, with the same class as the input.

Examples

```
ts_frequency(cbind(mdeaths, fdeaths), "year", "sum")
ts_frequency(cbind(mdeaths, fdeaths), "year", "sum")
ts_frequency(cbind(mdeaths, fdeaths), "quarter", "last")

ts_frequency(AirPassengers, 4, "sum")
ts_frequency(AirPassengers, 1, "sum")

# Note that incomplete years are omited by default
ts_frequency(EuStockMarkets, "year")
ts_frequency(EuStockMarkets, "year", na.rm = TRUE)
```

---

ts_ggplot *Plot Time Series, Using ggplot2*

Description

ts_ggplot() has the same syntax and produces a similar plot as ts_plot(), but uses the ggplot2 graphic system, and can be customized. With theme_tsbox() and scale_color_tsbox(), the output of ts_ggplot has a similar look and feel.

Usage

```
ts_ggplot(..., title, subtitle, ylab = "")

theme_tsbox(base_family = getOption("ts_font", ""), base_size = 12)

colors_tsbox()

scale_color_tsbox(...)

scale_fill_tsbox(...)
```

Arguments

...	ts-boxable time series, objects of class ts, xts, data.frame, data.table, or tibble. For scale_ functions, arguments passed to subfunctions.
title	title (optional)
subtitle	subtitle (optional)
ylab	ylab (optional)
base_family	base font family (can also be set via options)
base_size	base font size

Details

Both ts_plot() and ts_ggplot() combine multiple ID dimensions into a single dimension. To plot multiple dimensions in different shapes, facets, etc., use standard ggplot (see examples).

See Also

ts_plot(), for a simpler and faster plotting function. ts_dygraphs(), for interactive time series plots.

Examples

```
# using the ggplot2 graphic system
p <- ts_ggplot(total = ldeaths, female = fdeaths, male = mdeaths)
p

# with themes for the look and feel of ts_plot()
p + theme_tsbox() + scale_color_tsbox()

# also use themes with standard ggplot
suppressMessages(library(ggplot2))
df <- ts_df(ts_c(total = ldeaths, female = fdeaths, male = mdeaths))
ggplot(df, aes(x = time, y = value)) +
  facet_wrap("id") +
  geom_line() +
  theme_tsbox() +
  scale_color_tsbox()


## Not run:
library(dataseries)
dta <- ds(c("GDP.PBRTT.A.R", "CCI.CCIIR"), "xts")
ts_ggplot(ts_scale(ts_span(
    ts_c(
      `GDP Growth` = ts_pc(dta[, 'GDP.PBRTT.A.R']),
      `Consumer Sentiment Index` = dta[, 'CCI.CCIIR']
    ),
    start = "1995-01-01"
  ))) +
  ggplot2::ggtitle("GDP and Consumer Sentiment", subtitle = "normalized values") +
  theme_tsbox() +
  scale_color_tsbox()

## End(Not run)
```

ts_index *Indices from Levels or Percentage Rates*

Description

ts_index returns an index series, with value of 1 at base date. ts_compound builds an index from percentage change rates, starting with 1 and compounding the rates.

Usage

```
ts_compound(x, denominator = 100)

ts_index(x, base = NULL)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.
denominator	numeric, set equal to one if percentage change rate is given a decimal fraction
base	base date, character string, Date or POSIXct, at which the

Value

a ts-boxable time series, with the same class as the input.

Examples

```
head(ts_compound(ts_pc(ts_c(fdeaths, mdeaths))))
head(ts_index(ts_df(ts_c(fdeaths, mdeaths)), "1974-02-01"))

ts_plot(
  `My Expert Knowledge` = ts_chain(
    mdeaths,
    ts_compound(ts_bind(ts_pc(mdeaths), 15, 23, 33))),
  `So Far` = mdeaths,
  title = "A Very Manual Forecast"
)
```

ts_lag *Lag or Lead of Time Series*

Description

Shift time stamps in ts-boxable time series, either by a number of periods or by a fixed amount of time.

Usage

```
ts_lag(x, by = 1)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.
by	integer or character, either the number of shifting periods (integer), or an absolute amount of time (character). See details.

Details

The lag order, by, is defined the oposite way as in R base. Thus, -1 is a lead and +1 a lag.

If by is integer, the time stamp is shifted by the number of periods. This requires the series to be regular.

If by is character, the time stamp is shifted by a specific amount of time. This can be one of one of "sec", "min", "hour", "day", "week", "month", "quarter" or"year", optionally preceded by a (positive or negative) integer and a space, or followed by plural "s". This is passed to base::seq.Date(). This does not require the series to be regular.

Value

a ts-boxable time series, with the same class as the input. If time stamp shifting causes the object to be irregular, a data frame is returned.

Examples

```
ts_plot(AirPassengers, ts_lag(AirPassengers), title = "Illustrating the need for glasses")

head(ts_lag(AirPassengers, "1 month"))
head(ts_lag(AirPassengers, "1 year"))
head(ts_lag(ts_df(AirPassengers), "2 day"))
# head(ts_lag(ts_df(AirPassengers), "2 min")) not yet working
```

---

ts_long *Reshaping Multiple Time Series*

Description

Functions to reshape multiple time series from 'wide' to 'long' and vice versa. Note that long format data frames are ts-boxable objects, where wide format data frames are not.

Usage

```
ts_long(x)

ts_wide(x)
```

Arguments

x	a ts-boxable time series, or a wide data.frame, data.table, or tibble.

Value

object with the same class as input

Examples

```
df.wide <- ts_wide(ts_df(ts_c(mdeaths, fdeaths)))
head(df.wide)
head(ts_long(df.wide))
```

`ts_na_omit` *Omit NA values*

Description

Remove NA values in ts-boxable objects, turning explicit into implicit missing values.

Usage

```
ts_na_omit(x)
```

Arguments

x	ts-boxable time series, an object of class `ts`, `xts`, `zoo`, `data.frame`, `data.table`, `tbl`, `tbl_ts`, `tbl_time`, or `timeSeries`.

Details

Note that internal NAs in `ts` time series will not be removed, as this conflicts with the regular structure.

Value

a ts-boxable time series, with the same class as the input.

See Also

ts_regular, for the opposite, turning implicit into explicit missing values.

Examples

```
x <- AirPassengers
x[c(2, 4)] <- NA

# A ts object does only know explicit NAs
head(ts_na_omit(x))

# by default, NAs are implicit in data frames
head(ts_df(x))

# make NAs explicit
head(ts_regular(ts_df(x)))

# and implicit again
head(ts_na_omit(ts_regular(ts_df(x))))
```

ts_pc *First Differences and Percentage Change Rates*

Description

ts_pcy and ts_diffy calculate the percentage change rate and the difference compared to the previous period, ts_pcy and ts_diffy calculate compared to the same period of the previous year.

Usage

```
ts_pc(x)

ts_diff(x)

ts_pcy(x)

ts_diffy(x)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.

Value

a ts-boxable time series, with the same class as the input.

Examples

```
head(ts_diff(ts_c(fdeaths, mdeaths)))
head(ts_pc(ts_c(fdeaths, mdeaths)))
head(ts_pcy(ts_c(fdeaths, mdeaths)))
head(ts_diffy(ts_c(fdeaths, mdeaths)))
```

ts_pick *Pick Series (Experimental)*

Description

Pick (and optionally rename) series from multiple time series.

Usage

```
ts_pick(x, ...)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.
...	character string(s), names of the series to be picked. If arguments are named, the series will be renamed.

Value

a ts-boxable time series, with the same class as the input.

Examples

```
# Interactive use

ts_plot(ts_pick(
  EuStockMarkets,
  `My Dax` = "DAX",
  `My Smi` = "SMI"
))
head(ts_pick(EuStockMarkets, c(1, 2)))
head(ts_pick(EuStockMarkets, `My Dax` = 'DAX', `My Smi` = 'SMI'))


# Programming use
to.be.picked.and.renamed <- c(`My Dax` = "DAX", `My Smi` = "SMI")
head(ts_pick(EuStockMarkets, to.be.picked.and.renamed))
```

---

ts_plot *Plot Time Series*

Description

`ts_plot()` is a fast and simple plotting function for ts-boxable time series, with limited customizability. For more theme options, use `ts_ggplot()`.

Usage

```
ts_plot(..., title, subtitle, ylab = "", family = getOption("ts_font",
  "sans"))
```

Arguments

`...`	ts-boxable time series, objects of class `ts`, `xts`, `data.frame`, `data.table`, or `tibble`.
`title`	title (optional)
`subtitle`	subtitle (optional)
`ylab`	ylab (optional)
`family`	font family (optional, can also be set via `options`)

Details

Both `ts_plot()` and `ts_ggplot()` combine multiple ID dimensions into a single dimension. To plot multiple dimensions in different shapes, facets, etc., use standard ggplot.

Limited customizability of `ts_plot` is available via options. See examples.

See Also

`ts_ggplot()`, for a plotting function based on ggplot2. `ts_dygraphs()`, for interactive time series plots. `ts_save()` to save a plot to the file system.

Examples

```
ts_plot(
  AirPassengers,
  title = "Airline passengers",
  subtitle = "The classic Box & Jenkins airline data"
)

# naming arguments
ts_plot(total = ldeaths, female = fdeaths, male = mdeaths)

# using different ts-boxable objects
ts_plot(ts_scale(ts_c(
  ts_xts(airmiles),
  ts_tbl(co2),
  JohnsonJohnson,
  ts_df(discoveries)
)))

# customize ts_plot
op <- options(
  tsbox.lwd = 3,
  tsbox.col = c("gray51", "gray11"),
  tsbox.lty = "dashed"
)
ts_plot(
  "Female" = fdeaths,
  "Male" = mdeaths
)
options(op)  # restore defaults
```

---

ts_regular *Enforce Regularity*

Description

Enforces regularity in data frame and `xts` objects, by turning implicit `NA`s into explicit `NA`s. In `ts` objects, regularity is automatically enforced.

Usage

```
ts_regular(x)
```

Arguments

`x`	a ts-boxable time series

Examples

```
x0 <- AirPassengers
x0[c(10, 15)] <- NA
x <- ts_na_omit(ts_dts(x0))
ts_regular(x)
```

```
m <- mdeaths
m[c(10, 69)] <- NA
f <- fdeaths
f[c(1, 3, 15)] <- NA

ts_regular(ts_na_omit(ts_dts(ts_c(f, m))))
```

---

ts_save *Save Previous Plot*

Description

Save Previous Plot

Usage

```
ts_save(filename = tempfile(fileext = ".pdf"), width = 10, height = 5,
  device = NULL, open = TRUE)
```

Arguments

filename	filename
width	width
height	height
device	device
open	logical, should the saved plot be opened?

---

ts_scale *Normalized Time Series*

Description

Subtract mean and divide by standard deviation. Based on base::scale().

Usage

```
ts_scale(x, center = TRUE, scale = TRUE)
```

Arguments

x	ts_boxable time series
center	logical
scale	logical

Examples

```
ts_plot(ts_scale((ts_c(airmiles, co2, JohnsonJohnson, discoveries))))
ts_plot(ts_scale(ts_c(AirPassengers, DAX = EuStockMarkets[, 'DAX'])))
```

ts_span *Limit Time Span*

Description

Filter time series for a time span.

Usage

```
ts_span(x, start = NULL, end = NULL, template = NULL)

ts_start(x)

ts_end(x)
```

Arguments

x	ts-boxable time series, an object of class ts, xts, zoo, data.frame, data.table, tbl, tbl_ts, tbl_time, or timeSeries.
start	start date, character string, Date or POSIXct
end	end date, character string, Date or POSIXct.
template	ts-boxable time series, an object of class ts, xts, data.frame, data.table, or tibble. If provided, from and to will be extracted from the object.

Details

All date and times, when entered as character strings, are processed by anytime::anydate() or anytime::anytime(). Thus a wide range of inputs are possible. See examples.

start and end can be specified relative to each other, using one of "sec", "min", "hour", "day", "week", "month", "quarter" or"year", or an abbreviation. If the series are of the same frequency, the shift can be specified in periods. See examples.

Value

a ts-boxable time series, with the same class as the input.

Examples

```
# use 'anytime' shortcuts
ts_span(mdeaths, start = "1979")       # shortcut for 1979-01-01
ts_span(mdeaths, start = "1979-4")     # shortcut for 1979-04-01
ts_span(mdeaths, start = "197904")     # shortcut for 1979-04-01

# it's fine to use an to date outside of series span
ts_span(mdeaths, end = "2001-01-01")

# use strings to set start or end relative to each other

ts_span(mdeaths, start = "-7 month")   # last 7 months
ts_span(mdeaths, start = -7)           # last 7 periods
ts_span(mdeaths, start = -1)           # last single value
```

```
ts_span(mdeaths, end = "1e4 hours")    # first 10000 hours


ts_plot(
  ts_span(mdeaths, start = "-3 years"),
  title = "Three years ago",
  subtitle = "The last three years of available data"
)

ts_ggplot(
  ts_span(mdeaths, end = "28 weeks"),
  title = "28 weeks later",
  subtitle = "The first 28 weeks of available data"
) + theme_tsbox() + scale_color_tsbox()


# Limit span of 'discoveries' to the same span as 'AirPassengers'
ts_span(discoveries, template = AirPassengers)
```

`ts_trend` *Loess Trend Estimation*

Description

Trend estimation that uses `stats::loess()`.

Usage

```
ts_trend(x, ...)
```

Arguments

`x`	ts-boxable time series, an object of class `ts`, `xts`, `zoo`, `data.frame`, `data.table`, `tbl`, `tbl_ts`, `tbl_time`, or `timeSeries`.
`...`	arguments, passed to `stats::loess()`: • `degree` degree of Loess smoothing • `span` smoothing parameter, if `NULL`, an automated search performed (see Details)

Examples

```
ts_plot(
   `Raw series` = fdeaths,
   `Loess trend` = ts_trend(fdeaths),
   title = "Deaths from Lung Diseases",
   subtitle = "per month"
)
```

ts_ts *Convert Everything to Everything*

Description

tsbox is built around a set of converters, which convert time series stored as `ts`, `xts`, `data.frame`, `data.table` or `tibble` to each other.

Usage

```
ts_data.frame(x)

ts_df(x)

ts_data.table(x)

ts_dt(x)

ts_tbl(x)

ts_tibbletime(x)

ts_timeSeries(x)

ts_ts(x)

ts_tsibble(x)

ts_tslist(x)

ts_xts(x)

ts_zoo(x)
```

Arguments

`x`	ts-boxable time series, an object of class `ts`, `xts`, `zoo`, `data.frame`, `data.table`, `tbl`, `tbl_ts`, `tbl_time`, or `timeSeries`.

Details

In data frames, multiple time series will be stored in a 'long' format. tsbox detects a *value*, a *time* and zero to several *id* columns. Column detection is done in the following order:

1. Starting **on the right**, the first first `numeric` or `integer` column is used as **value column**.
2. Using the remaining columns, and starting on the right again, the first `Date`, `POSIXct`, `numeric` or `character` column is used as **time column**. `character` strings are parsed by `anytime::anytime()`. The time stamp, `time`, indicates the beginning of a period.
3. **All remaining** columns are **id columns**. Each unique combination of id columns points to a time series.

Alternatively, the **time** column and the **value** column to be explicitly named as `time` and `value`. If explicit names are used, the column order will be ignored.

Whenever possible, tsbox relies on **heuristic time conversion**. When a monthly `"ts"` time series, e.g., `AirPassengers`, is converted to a data frame, each time stamp (of class `"Date"`) is the first day of the month. In most circumstances, this reflects the actual meaning of the data stored in a `"ts"` object. Technically, of course, this is not correct: `"ts"` objects divide time in period of equal length, while in reality, February is shorter than January. Heuristic conversion is done for frequencies of 0.1 (decades), 1 (years), 4 (quarters) and 12 (month).

For other frequencies, e.g. 260, of `EuStockMarkets`, tsbox uses **exact time conversion**. The year is divided into 260 equally long units, and time stamp of a period will be a point in time (of class `"POSIXct"`).

Value

ts-boxable time series of the desired class, an object of class `ts`, `xts`, `data.frame`, `data.table`, or `tibble`.

Examples

```
x.ts <- ts_c(mdeaths, fdeaths)
head(x.ts)
head(ts_df(x.ts))

suppressMessages(library(dplyr))
head(ts_tbl(x.ts))

suppressMessages(library(data.table))
head(ts_dt(x.ts))

suppressMessages(library(xts))
head(ts_xts(x.ts))

# heuristic time conversion
# 1 momth: approx. 1/12 year
head(ts_df(AirPassengers))

# exact time conversion
# 1 trading day: exactly 1/260 year
head(ts_df(EuStockMarkets))

# multiple id
multi.id.df <- rbind(
  within(ts_df(ts_c(fdeaths, mdeaths)), type <- "level"),
  within(ts_pc(ts_df(ts_c(fdeaths, mdeaths))), type <- "pc")
)
head(ts_ts(multi.id.df))
ts_plot(multi.id.df)
```

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