Package ‘timeDate’

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Title Rmetrics - Chronological and Calendar Objects

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Description The ‘timeDate’ class fulfils the conventions of the ISO 8601 standard as well as of the ANSI C and POSIX standards. Beyond these standards it provides the ”Financial Center“ concept which allows to handle data records collected in different time zones and mix them up to have always the proper time stamps with respect to your personal financial center, or alternatively to the GMT reference time. It can thus also handle time stamps from historical data records from the same time zone, even if the financial centers changed day light saving times at different calendar dates.

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Suggests RUnit

License GPL (>= 2)


BugReports https://r-forge.r-project.org/projects/rmetrics

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Author Diethelm Wuertz [aut] (original code), Tobias Setz [aut], Yohan Chalabi [aut], Martin Maechler [ctb] (<https://orcid.org/0000-0002-8685-9910>), Joe W. Byers [ctb], Georgi N. Boshnakov [cre, aut]

Maintainer Georgi N. Boshnakov <georgi.boshnakov@manchester.ac.uk>

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Package of calendar, date, time tools and utilities for Rmetrics.

Overview of Topics

This help file describes the concepts and methods behind the S4 "timeDate" class used in Rmetrics for financial data and time management together with the management of public and ecclesiastical holidays.

The "timeDate" class fulfills the conventions of the ISO 8601 standard as well as of the ANSI C and POSIX standards. Beyond these standards it provides the "Financial Center" concept which allows to handle data records collected in different time zones and mix them up to have always the proper time stamps with respect to your personal financial center, or alternatively to the GMT reference time. It can thus also handle time stamps from historical data records from the same time zone, even if the financial centers changed day light saving times at different calendar dates.

Moreover "timeDate" is almost compatible with the "timeDate" class in Insightful's SPlus "timeDate" class. If you move between the two worlds of R and SPlus, you will not have to rewrite your code. This is important for business applications.

The "timeDate" class offers not only date and time functionality but it also offers sophisticated calendar manipulations for business days, weekends, public and ecclesiastical holidays.

This help page is presented in four sections:

1. S4 "timeDate" Class and Functions
2. Operations on "timeDate" Objects
3. Daylight Saving Time and Financial Centers
4. Holidays and Holiday Calendars
1. S4 "timeDate" Class and Generator Functions

Date and time stamps are represented by an S4 object of class "timeDate".

```r
setClass("timeDate",
 representation(
 Data = "POSIXct",
 format = "character",
 FinCenter = "character"
 ))
```

They have three slots. The @Data slot holds the time stamps which are POSIXct formatted as specified in the @format slot. The time stamps are local and belong to the financial center expressed through the slot @FinCenter.

There are several possibilities to generate a "timeDate" object. The most forward procedure is to use one of the following functions:

- `timeDate` – Creates a "timeDate" object from scratch,
- `timeSequence` – creates a sequence of "timeDate" objects,
- `timeCalendar` – creates a "timeDate" object from calendar atoms,
- `Sys.timeDate` – returns the current date and time as a "timeDate" object.

With the function `timeDate` you can create "timeDate" objects from scratch by specifying a character vector of time stamps and a financial center which the character vector belongs to. "GMT" is used by default as the reference for all date/time operations. But you can set the variable `myFinCenter` to your local financial center reference if you want to reference dates/time to it.

Examples:

```r
# Show My local Financial Center - Note, by Default this is "GMT"
getRmetricsOptions("myFinCenter")

# Compose Character Vectors of Dates and Times:
Times <- c( "23:12:55", "10:34:02", "08:30:00", "11:18:23")
charvec = paste(Dates, Times)

# Create a 'timeDate' object
timeDate(charvec)

# Create a 'timeDate' object with my financial center set to Zurich
myFinCenter <- "Zurich"
timeDate(charvec)

# if the 'timeDate' was recorded in a different financial center, it
# will be automatically converted to your financial center,
# i.e. "Zurich".
```
timeDate-package

```
  timeDate(charvec, zone = "Tokyo")

  # You can also convert a recorded 'timeDate' from your financial
  # center "Zurich" to another one, for example "NewYork".
  timeDate(charvec, FinCenter = "NewYork")
```

NOTE: Rmetrics has implemented an automated date/time format identifier for many common
date/time formats which tries to automatically recognise the format for the character vector of dates
and times. You can have a look at
whichFormat(charvec).

NOTE: Rmetrics always uses the midnight standard on dates and times. You can see it with
.midnightStandard("2008-01-31 24:00:00")

Alternatively we can create a sequence of "timeDate" objects with the help of the function timeSequence.
This can be done in several ways, either by specifying the range of the data through the arguments
from and to, or when from is missing, by setting the argument length.out of the desired series.
Note in the case of a monthly sequence, you have further options. For example you can generate
the series with the first or last day in each month, or use more complex rules like the last or n-th
Friday in every month.

Examples:

```
  # Lets work in an international environment:
  setRmetricsOptions(myFinCenter = "GMT")

  # Your 'timeDate' is now in the Financial Center "GMT"
  timeDate(charvec)

  # Daily January 2008 Sequence:
  timeSequence(from = "2008-01-01", to = "2008-01-31", by = "day")

  # Monthly 2008 Sequence:
  tS = timeSequence(from = "2008-01-01", to = "2008-12-31", by = "month")
  tS

  # Do you want the last Day or the last Friday in Month Data ?
  timeLastDayInMonth(tS)
  timeLastNdayInMonth(tS, nday = 5)
```

A third possibility is to create "timeDate" objects from calendar atoms. You can specify values or
vectors of equal length of integers denoting year, month, day, hour, minute and seconds. If every
day has the same time stamp, you can just add an offset.
Examples:

# Monthly calendar for Current Year
getRmetricsOptions("currentYear")
timeCalendar()

# Daily 'timeDate' for January data from Tokyo local time 16:00
timeCalendar(2008, m=1, d=1:31, h=16, zone="Tokyo", FinCenter="Zurich")

# Or add16 hours in seconds ...
timeCalendar(2008, m=1, d=1:31, zone="Tokyo", FinCenter="Zurich") + 16*3600

2. Operations on "timeDate" Objects

Many operations can be performed on "timeDate" objects. You can add and subtract, round and truncate, subset, coerce or transform them to other objects. These are only few options among many others.

Math Operations

Math operations can add and subtract dates and times, and perform logical operations on "timeDate" objects.

Examples:

# Date and Time Now:
now = Sys.timeDate()

# One Hour Later:
now + 3600

# Which date/time is earlier or later ?
tC = timeCalendar()
tR = tC + round(3600*rnorm(12))
tR > tC

Lagging

You can generate suitable lagged and iterated differences:

diff.timeDate – Returns suitably lagged and iterated differences.

Examples:
# Monthly Dates 2008 and January 2009:
\[ \text{tC} = \text{c(timeCalendar(2008), timeCalendar(2009)[1])} \]

# Number of days in months and total 2008:
\[ \text{diff(tC)} \]
\[ \text{sum(as.integer(diff(tC)))} \]

### Rounding and Truncating

Dates and times can be rounded or truncated. This is useful for lower frequencies than seconds, for example hourly.

- `round` - rounds objects of class "timeDate",
- `trunc` - truncates objects of class "timeDate".

Examples:

- # Round the Random Time Stamps to the Nearest Hour:
  \[ \text{tC} = \text{timeCalendar()} \]
  \[ \text{tR} = \text{tC} + \text{round(3600*runif(12))} \]
  \[ \text{tR} \]
  \[ \text{round(tR, "h")} \]

- # Truncate by Hour or to the Next Full Hour::
  \[ \text{trunc(tR, "h")} \]
  \[ \text{trunc(tR + 3600, "h")} \]

### Subsetting

Subsetting a "timeDate" is a very important issue in the management of dates and times. Rmetrics offers several functions which are useful in this context:

- "[" - Extracts or replaces subsets from "timeDate" objects,
- `window`, `cut` - extract a piece from a "timeDate" object,

In this context it is also important to know the start and the end time stamp together with the total number of time stamps.

- `start` - extracts the first entry of a "timeDate" object,
- `end` - extracts the last entry of a "timeDate" object,
- `length` - returns the length of a "timeDate" object.

Examples:
# Create Monthly Calendar for next year
\[ tC = \text{timeCalendar(getRmetricsOptions("currentYear") + 1)} \]
\[ tC \]

# Start, end and length of 'timeDate' objects
\[ \text{start}(tC) \]
\[ \text{end}(tC) \]
\[ \text{length}(tC) \]

# The first Quarter - Several Alternative Solutions:
\[ tC[1:3] \]
\[ tC[-(4:length(tC))] \]
\[ \text{window}(tC, \text{start} = tC[1], \text{end} = tC[3]) \]
\[ \text{cut}(tC, \text{from} = tC[1], \text{to} = tC[3]) \]
\[ tC[tC < tC[4]] \]

# The Quarterly Series:
\[ tC[\text{seq}(3, 12, \text{by} = 3)] \]

Weekdays, weekends, business days, and holidays can be easily obtained with the following functions:

\( \text{isWeekday} \) – tests if a date is a weekday or not,
\( \text{isWeekend} \) – tests if a date is a weekend day or not,
\( \text{isBizday} \) – tests if a date is a business day or not,
\( \text{isHoliday} \) – tests if a date is a holiday day or not.

Examples:

# A 'timeDate' Sequence around Easter 2008
\[ \text{Easter}(2008) \]
\[ tS \leftarrow \text{timeSequence(Easter}(2008, -14), \text{Easter}(2008, +14)) \]
\[ tS \]

# Subset weekdays and business days:
\[ \text{tW} \leftarrow tS[\text{isWeekday}(tS)]; \text{tW} \]
\[ \text{dayOfWeek}(tW) \]
\[ \text{tB} \leftarrow tS[\text{isBizday}(tS, \text{holidayZURICH})]; \text{tB} \]
\[ \text{dayOfWeek}(tB) \]
The functions `blockStart` and `blockEnd` give time stamps for equally sized blocks.

- `blockStart` – Creates start dates for equally sized blocks,
- `blockEnd` – Creates end dates for equally sized blocks.

Examples:

```r
# 'timeDate' object for the last 365 days:
tS = timeSequence(length.out = 360)
tS

# Subset Pointers for blocks of exactly 30 days:
blockStart(tS, 30)
blockEnd(tS, 30)
Sys.timeDate()
```

**Coercions and Transformations**

"timeDate" objects are not living in an isolated world. Coercions and transformations allow "timeDate" objects to communicate with other formatted time stamps. Be aware that in most cases information can be lost if the other date.time classes do not support this functionality. There exist several methods to coerce and transform "timeDate" objects into other objects.

- `as.timeDate` – Implements Use Method,
- `as.timeDate.default` – default Method,
- `as.timeDate.POSIXt` – returns a 'POSIX' object as "timeDate" object,
- `as.timeDate.Date` – returns a 'POSIX' object as "timeDate" object.

- `as.character.timeDate` – Returns a "timeDate" object as 'character' string,
- `as.double.timeDate` – returns a "timeDate" object as 'numeric' object,
- `as.data.frame.timeDate` – returns a "timeDate" object as 'data.frame' object,
- `as.POSIXct.timeDate` – returns a "timeDate" object as 'POSIXct' object,
- `as.POSIXlt.timeDate` – returns a "timeDate" object as 'POSIXlt' object,
- `as.Date.timeDate` – returns a "timeDate" object as 'Date' object.

Users or maintainers of other date/time classes can add their own generic functions. For example `as.timeDate.zoo` and `as.zoo.timeDate`.

**Concatenations and Reorderings**

It might be sometimes useful to concatenate or reorder "timeDate" objects. The generic functions to concatenate, replicate, sort, re-sample, unify and revert a "timeDate" objects are:
c – Concatenates "timeDate" objects,
rep – replicates a "timeDate" object,
sort – sorts a "timeDate" object,
sample – resamples a "timeDate" object,
unique – makes a "timeDate" object unique,
rev – reverts a "timeDate" object.

NOTE: The function c of a "timeDate" objects takes care of possible different financial centers specific to each object to be concatenated. In such cases, all time stamps will be transformed to the financial center of the first time stamp used in the concatenation:

Examples:

    # Concatenate the local time stamps to Zurich time ...
    ZH = timeDate("2008-01-01 16:00:00", zone = "GMT", FinCenter = "Zurich")
    NY = timeDate("2008-01-01 18:00:00", zone = "GMT", FinCenter = "NewYork")
    c(ZH, NY)
    c(NY, ZH)

    # Rordering:
    tC = timeCalendar(); tC
    tS = sample(tC); tS
    tO = sort(tS); tO
    tV = rev(tO); tV
    tU = unique(c(tS, tS)); tU

3. Daylight Saving Time and Financial Centers

Each financial center worldwide has a function which returns Daylight Saving Time Rules. Almost 400 prototypes are made available through the Olson time zone data base. The cities and regions can be listed using the command listFinCenter. The DST rules for specific financial center can be viewed by their name, e.g. Zurich(). Additional financial centers can be added by the user taking care of the format specification of the DST functions.

Setting Financial Centers

All time stamps are handled according to the time zone and daylight saving time rules specified by the center through the variable myFinCenter. This variable is set by default to "GMT" but can be changed to your local financial center or to any other financial center you want to use.

NOTE: By setting the financial center to a continent/city which lies outside of the time zone used by your computer does not change any time settings or environment variables used by your computer.

To change the name of a financial center from one setting to another just assign to the variable myFinCenter the desired name of the city:

Examples:
# What is my current Financial Center?
getRmetricsOptions("myFinCenter")

# Change to Zurich:
setRmetricsOptions(myFinCenter = "Zurich")
getRmetricsOptions("myFinCenter")

From now on, all dates and times are handled within the middle European time zone and the DST rules which are valid for Zurich.

**List of Financial Centers**

There are many other financial centers supported by Rmetrics. They can be displayed by the function `listFinCenter`. You can also display partial lists with wildcards and regular expressions:

Examples:

```r
# List all supported Financial Centers Worldwide:
listFinCenter()

# List European Financial Centers:
listFinCenter("Europe/*")
```

**DST Rules**

For each financial center a function is available. It keeps the information of the time zones and the DST rules. The functions return a data.frame with 4 Columns:

```
<table>
<thead>
<tr>
<th>Zurich</th>
<th>Offset</th>
<th>IsDST</th>
<th>TimeZone</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>2008-03-30 01:00:00</td>
<td>7200</td>
<td>1</td>
</tr>
<tr>
<td>63</td>
<td>2008-10-26 01:00:00</td>
<td>3600</td>
<td>0</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

The first column describes when the time was changed, the second gives the offset to "GMT", the third returns the daylight savings time flag which is positive if in force, zero if not, and negative if unknown. The last column gives the name of the time zone. You can have a look at the function `Zurich()`:

Examples:

```r
# Show the DST Rules for Zurich:
Zurich()

# List European Financial Centers:
listFinCenter("Europe/*")
3. Holidays and Holiday Calendars

It is non-trivial to implement function for business days, weekends and holidays. It is not difficult in an algorithmic sense, but it can become tedious to implement the rules of the calendar themselves, for example the date of Easter.

In the following section we briefly summarise the functions which can calculate dates of ecclesiastical and public holidays. With the help of these functions we can also create business and holiday calendars.

Special Dates:
The implemented functions can compute the last day in a given month and year, the dates in a month that is a n-day (e.g. n- = Sun) on or after a given date, the dates in a month that is a n-day on or before a specified date, the n-th occurrences of a n-day for a specified year/month vectors, or the last n-day for a specified year/month value or vector.

NOTE: n-days are numbered from 0 to 6 where 0 correspond to the Sunday and 6 to the Saturday.

timeFirstDayInMonth – Computes the first day in a given month and year,
timeLastDayInMonth – Computes the last day in a given month and year,
timeFirstDayInQuarter – Computes the first day in a given quarter and year,
timeLastDayInQuarter – Computes the last day in a given quarter and year,

timeNdayOnOrAfter – Computes date that is a "on-or-after" n-day,
timeNdayOnOrBefore – Computes date that is a "on-or-before" n-day,

timeNthNdayInMonth – Computes n-th occurrence of a n-day in year/month,
timeLastNdayInMonth – Computes the last n-day in year/month.

Holidays:
Holidays may have two origins: ecclesiastical or public/federal. The ecclesiastical calendars of Christian churches are based on cycles of movable and immovable feasts. Christmas, December 25, is the principal immovable feast. Easter is the principal movable feast, and dates of most of the other movable feasts are determined with respect to Easter. However, the movable feasts of the Advent and Epiphany seasons are Sundays reckoned from Christmas and the Feast of the Epiphany, respectively.

Examples:

```r
# List Holidays available in Rmetrics
listHolidays()

# The date of Easter for the next 5 years:
currentYear <- getRmetricsOptions("currentYear")
Easter(currentYear:(currentYear+5))
```

Holiday Calendars:
holidayZURICH – Zurich Business Calendar,  
holidayNYSE – NYSE Stock Exchange Holiday Calendar,  
holidayZURICH – TSX Holiday Calendar.

We would like to thanks all Rmetrics users who gave us many additional information concerning local holidays.

References


---

### .endpoints

**Endpoints indexes**

Returns endpoint indexes from a "timeDate" object.

#### Usage

```r
.endpoints(x, on = c("months", "years", "quarters", "weeks", "days",  
                    "hours", "minutes", "seconds"), k=1)
```

#### Arguments

- **x**
  - a "timeDate" object.

- **on**
  - the periods endpoints to find as a character string. Select from: "months", "years", "quarters", "weeks", "days", "hours", "minutes", "seconds".

- **k**
  - along every k-th element.

#### Details

.endpoints returns an integer vector corresponding to the last observation in each period specified by on, with a zero added to the beginning of the vector, and the index of the last observation in x at the end.
Value

an integer vector of endpoints beginning with 0 and ending with the value equal to the length of the x argument

Author(s)

Jeff Ryan, modified by Diethelm Wuertz for "timeDate" objects.

Examples

```r
## endpoints -

# Weekly Endpoints:
.endspoints(timeCalendar(), on="w")
```

align

Align a 'timeDate' object to regular date/time stamps

Description

Aligns a "timeDate" object to regular date/time stamps.

Usage

```r
## S4 method for signature 'timeDate'
align(x, by = "1d", offset = "0s")

alignDaily(x, include.weekends=FALSE)
alignMonthly(x, include.weekends=FALSE)
alignQuarterly(x, include.weekends=FALSE)
```

Arguments

- **x**: an object of class "timeDate".
- **by**: a character string formed from an integer length and a period identifier. Valid values are "w", "d", "h", "m", "s", for weeks, days, hours, minutes and seconds. For example a bi-weekly period is expressed as "2w".
- **offset**: a character string to set an offset formed from an integer length and a period identifier in the same way as for argument by.
- **include.weekends**: logical value indicating whether weekends should be included.

Details

The functions alignDaily, alignMonthly, alignQuarterly are simple to use functions which generate end-of-day, end-of-month, and end-of quarter "timeDate" objects. Weekends are excluded by default. Optionally they can be added setting the argument include.weekends = TRUE.
Value

an object of class "timeDate"

Examples

## align -

# Align Bi-Weekly with a 3 Days Offset:
(tC <- timeCalendar())
align(tC, by = "2w", offset = "3d")

## alignDaily -

# Simple to use Functions:
alignDaily(tC)
alignDaily(tC, include.weekends=TRUE)

# Align to end-of-month Dates:
alignMonthly(tC)

---

**as.timeDate** | Coercion from/to 'timeDate'

Description

Coerce and transform objects of class “timeDate”.

Usage

## methods for base R functions

## S3 method for class 'timeDate'
as.character(x, ...)

## S3 method for class 'timeDate'
as.double(x,
    units = c("auto", "secs", "mins", "hours", "days", "weeks"), ...)

## S3 method for class 'timeDate'
as.data.frame(x, ...)

## S3 method for class 'timeDate'
as.POSIXct(x, tz = ",", ...)

## S3 method for class 'timeDate'
as.POSIXlt(x, tz = ",", ...)

## S3 method for class 'timeDate'
as.Date(x, method = c("trunc", "round", "next"), ...)  
## methods for as.timeDate  
## Default S3 method:  
## as.timeDate(x, zone = "", FinCenter = "")  
## S3 method for class 'POSIXt'  
## as.timeDate(x, zone = "", FinCenter = "")  
## S3 method for class 'Date'  
## as.timeDate(x, zone = "", FinCenter = "")  
## S3 method for class 'timeDate'  
## as.timeDate(x, zone = x@FinCenter, FinCenter = "")  

Arguments  
  FinCenter a character with the location of the financial center named as "continent/city".  
  method a character string denoting the method how to determine the dates.  
  tz inputs the time zone to POSIX objects, i.e. the time zone, zone, or financial center string, FinCenter, as used by "timeDate" objects.  
  units a character string denoting the date/time units in which the results are desired.  
  x an object of class "timeDate".  
  zone the time zone or financial center where the data were recorded.  
... arguments passed to other methods.  

Value  
for as.timeDate.POSIXt, an object of class "timeDate".  
for as.timeDate.Date, an object of class "timeDate"  

Examples  
  ## timeDate -  
  tC = timeCalendar()  
  ## Convert 'timeDate' to a character strings:  
  as.character(tC)  
  ## Coerce a 'Date' object into a 'timeDate' object:  
  as.timeDate(Sys.Date())
Equally sized 'timeDate' blocks

Description

Creates start (end) dates for equally sized "timeDate" blocks.

Usage

blockStart(x, block = 20)
blockEnd(x, block = 20)

Arguments

block an integer value specifying the length in number of records for numerically sized blocks of dates.

x an object of class "timeDate".

Details

The functions blockStart and blockEnd create vectors of start and end values for equally sized "timeDate" blocks. Note, the functions are event counters and not a time counter between measuring time intervals between start and end dates! For equally sized blocks in time one has before to align the time stamps in equal time differences.

Value

an object of class "timeDate"

Examples

## timeSequence
# 360 Days Series:
  tS <- timeSequence(to = "2022-09-23 09:39:23", length.out = 360)

## blockStart | blockEnd -
  Start <- blockStart(tS, 30)
  End <- blockEnd(tS, 30)
  Start
  End
  End - Start
**c**

*Concatenating 'timeDate' objects*

**Description**

Concatenates "timeDate" objects.

**Usage**

```r
## S3 method for class 'timeDate'
c(..., recursive = FALSE)
```

**Arguments**

- `recursive` a logical. If recursive is set to TRUE, the function recursively descends through lists combining all their elements into a vector.
- `...` arguments passed to other methods.

**Value**

an object of class "timeDate"

**Examples**

```r
## timeCalendar -
# Create Character Vectors:
GMT = timeCalendar(zone = "GMT", FinCenter = "GMT") + 16*3600
ZUR = timeCalendar(zone = "GMT", FinCenter = "Zurich") + 16*3600

## c -
# Concatenate and Replicate timeDate Objects:
sort(c(GMT, ZUR))
sort(c(ZUR, GMT))
```

---

**currentYear**

*Current year*

**Description**

A variable containing the current year.

**Note**

It is not allowed to change this variable.
Examples

### currentYear -
getRmetricsOptions("currentYear")

---

DaylightSavingTime  Daylight Saving Time Rules

Description

Functions for about 400 cities and regions which return daylight saving time rules and time zone offsets.

Details

As a selection of these functions:


Note

There are currently two synonyms available "Pacific" for Los Angeles and "Eastern" for New York. Specific time zones (AST, CET, CST, EET, EST, MST and PST) are also available.

Note we leave the space in all double named cities like New York or Hong Kong and use an underscore for it.

All the entries are retrieved from the tzdata library which is available under GNU GPL licence.

Examples

### DST Rules for Zurich:
head(Zurich())
tail(Zurich())

### list all available centers
listFinCenter()
**dayOfWeek**

**Description**

Returns the days of the week of the data in a "timeDate" object.

**Usage**

dayOfWeek(x)

**Arguments**

x  
an object of class "timeDate".

**Value**

a character vector giving the days of the week corresponding to the elements of x. The names are in English, abbreviated to three letters.

**See Also**

dayOfYear

**Examples**

```r
## timeCalendar -
tC = timeCalendar(2022)

## The days of the Year:
dayOfWeek(tC)
```

**dayOfYear**

**Description**

Returns the days of the year of the data in a "timeDate" object.

**Usage**

dayOfYear(x)

**Arguments**

x  
an object of class "timeDate".
### diff

vector of integers representing the number of days since the beginning of the year. For January, 1st it is one.

**See Also**

`dayOfWeek`

**Examples**

```r
## timeCalendar -
tC = timeCalendar(2022)

## The days of the Year:
dayOfYear(tC)
```

---

### diff

**Lagged 'timeDate' differences**

#### Description

Returns suitably lagged and iterated differences.

#### Usage

```r
## S3 method for class 'timeDate'
diff(x, lag = 1, differences = 1, ...)
```

#### Arguments

- `x`: an object of class "timeDate".
- `lag`: an integer indicating which lag to use.
- `differences`: an integer indicating the order of the difference.
- `...`: arguments passed to other methods.

#### Value

For the function, `diff.timeDate`, if `x` is a vector of length `n` and `differences`=1, then the computed result is equal to the successive differences `x[(1+lag):n] - x[1:(n-lag)]`. If difference is larger than one this algorithm is applied recursively to `x`. Note that the returned value is a vector which is shorter than `x`. 
Examples

```r
## Create Character Vectors:
dts
tms = c("23:12:55", "10:34:02", "08:30:00", "11:18:23")
tms

## timeDate -
GMT = timeDate(dts, zone = "GMT", FinCenter = "GMT") + 24*3600
GMT
ZUR = timeDate(dts, zone = "GMT", FinCenter = "Europe/Zurich")
ZUR

## diff -
# Suitably Lagged and Iterated Differences:
diff(GMT)
diff(GMT, lag = 2)
diff(GMT, lag = 1, diff = 2)
```

difftimeDate

### Difference of two `timeDate` objects

**Description**

Returns the difference of two `timeDate` objects.

**Usage**

```r
difftimeDate(time1, time2, units = c("auto", "secs", "mins", "hours", "days", "weeks"))
```

**Arguments**

- `time1, time2` two objects objects of class "timeDate".
- `units` a character string denoting the date/time units in which the results are desired.

**Value**

The function, `difftimeDate`, takes a difference of two "timeDate" objects and returns an object of class "difftime" with an attribute indicating the units.

**Examples**

```r
## Create Character Vectors:
dts

## timeDate -
GMT = timeDate(dts, zone = "GMT", FinCenter = "GMT")
```
Easter

GMT

## diff -
## Suitably Lagged and Iterated Differences:

difftimeDate(GMT[1:2], GMT[-(1:2)])

### Easter

<table>
<thead>
<tr>
<th>Easter</th>
<th>Date of Easter</th>
</tr>
</thead>
</table>

**Description**

Returns the date of Easter.

**Usage**

Easter(year = getRmetricsOptions("currentYear"), shift = 0)

**Arguments**

- **year**: an integer value or integer vector for the year(s).
- **shift**: an integer value, the number of days shifted from the Easter date. Negative integers are allowed.

**Details**

Holidays may have two origins, ecclesiastical and public/federal. The ecclesiastical calendars of Christian churches are based on cycles of moveable and immoveable feasts. Christmas, December 25th, is the principal immoveable feast. Easter is the principal moveable feast, and dates of most other moveable feasts are determined with respect to Easter.

The date of Easter is evaluated by a complex procedure whose detailed explanation goes beyond this description. The reason that the calculation is so complicated is, because the date of Easter is linked to (an inaccurate version of) the Hebrew calendar. But nevertheless a short answer to the question "When is Easter?" is the following: Easter Sunday is the first Sunday after the first full moon after vernal equinox. For the long answer we refer to Toendering (1998).

The algorithm computes the date of Easter based on the algorithm of Oudin (1940). It is valid for any Gregorian Calendar year.

**Value**

the date of Easter as an object of class "timeDate"

**Note**

Doesn’t have options to compute Eastern Orthodox Easter dates.
Examples

## Easter -

# Current Year:
Easter()

# From 2001 to 2010:
Easter(2001:2010)

### Description

Get or set the financial center of a "timeDate" object.

### Usage

```
## S4 method for signature 'timeDate'
finCenter(x)
## S4 replacement method for signature 'timeDate'
finCenter(x) <- value
```

### Arguments

- `x` a `timeSeries` object.
- `value` a character with the location of the financial center named as "continent/city".

### Details

"timeDate" objects store the time in the GMT time zone. The financial center specifies a location whose local time is to be used to format the object, e.g., for printing.

`finCenter` gives the financial center associated with a ‘timeDate’ object. The assignment form changes it to the specified value. Both functions are S4 generics. This page describes the methods defined in package ‘timeDate’.

### See Also

- `listFinCenter`

### Examples

```r
date <- timeDate("2008-01-01")
finCenter(date) <- "GMT"
date
format(date)
finCenter(date) <- "Zurich"
```
Description
Computes the first/last day in a given month/quarter.

Usage

timeFirstDayInMonth(charvec, format = "%Y-%m-%d", zone = "", FinCenter = "")
timeLastDayInMonth(charvec, format = "%Y-%m-%d", zone = "", FinCenter = "")
timeFirstDayInQuarter(charvec, format = "%Y-%m-%d", zone = "", FinCenter = "")
timeLastDayInQuarter(charvec, format = "%Y-%m-%d", zone = "", FinCenter = ")

Arguments
charvec a character vector of dates and times.
format the format specification of the input character vector.
zone the time zone or financial center where the data were recorded.
FinCenter a character with the location of the financial center named as "continent/city".

Details
The functions timeLastDayInMonth and timeLastDayInMonth return the last or first day, respectively, in a given month and year.

The same functionality for quarterly time horizons is returned by the functions timeLastDayInQuarter and timeLastDayInQuarter.

Value
an object of class "timeDate"
Examples

```r
## Date as character String:
charvec = "2006-04-16"
myFinCenter = getRmetricsOptions("myFinCenter")

## timeLastDayInMonth -
# What date has the last day in a month for a given date ?
timeLastDayInMonth(charvec, format = "%Y-%m-%d",
zone = myFinCenter, FinCenter = myFinCenter)
timeLastDayInMonth(charvec)
timeLastDayInMonth(charvec, FinCenter = "Zurich")

## timeFirstDayInMonth -
# What date has the first day in a month for a given date ?
timeFirstDayInMonth(charvec)

## timeLastDayInQuarter -
# What date has the last day in a quarter for a given date ?
timeLastDayInQuarter(charvec)

## timeFirstDayInQuarter -
# What date has the first day in a quarter for a given date ?
timeFirstDayInQuarter(charvec)

## timeNdayOnOrAfter
# What date has the first Monday on or after March 15, 1986 ?
timeNdayOnOrAfter("1986-03-15", 1)

## timeNdayOnOrBefore
# What date has Friday on or before April 22, 1977 ?
timeNdayOnOrBefore("1986-03-15", 5)

## timeNthNdayInMonth -
# What date is the second Monday in April 2004 ?
timeNthNdayInMonth("2004-04-01", 1, 2)

## timeLastNdayInMonth -
# What date has the last Tuesday in May, 1996 ?
timeLastNdayInMonth("1996-05-01", 2)
```

Description

Formats "timeDate" objects as ISO conform character strings.

Usage

```r
## S3 method for class 'timeDate'
format(x, format = ",", tz = ",", usez = FALSE, ...)
```
Arguments

format  a character string describing the format.
tz  a timezone specification to be used for the conversion.
usetz  a logical.
x  an object of class "timeDate".
...  arguments passed to other methods.

Value

an ISO conforming formatted character string

See Also

as.character

Examples

## timeCalendar -
# Time Calendar 16:00
tC = timeCalendar() + 16*3600
tC

## Format as ISO Character String:
format(tC)

<table>
<thead>
<tr>
<th>holiday</th>
<th>Holiday dates</th>
</tr>
</thead>
</table>

Description

Returns the date of a holiday.

Usage

holiday(year = getRmetricsOptions("currentYear"), Holiday = "Easter")

Arguments

Holiday  the function name (a character string or unquoted) of an ecclesiastical or public holiday in the G7 countries or Switzerland, see the list below. Can also be a character vector to specify several holidays.

year  an integer value or vector of years, formatted as YYYY.
Details

Easter is the central ecclesiastical holiday. Many other holidays are related to this feast. The function `Easter` computes the dates of Easter and related ecclesiastical holidays for the requested year vector. `holiday` calculates the dates of ecclesiastical or public holidays in the G7 countries, e.g. `holiday(2003, "GoodFriday")`. Rmetrics contains holiday functions automatically loaded at startup time. The user can add easily additional holiday functions. The information for the holidays is collected from several web pages about holiday calendars. The following ecclesiastical and public holiday functions in the G7 countries and Switzerland are available:

*Holidays Related to Easter:*
Septuagesima, Quinquagesima, AshWednesday, PalmSunday, GoodFriday, EasterSunday, Easter, EasterMonday, RogationSunday, Ascension, Pentecost, PentecostMonday, TrinitySunday CorpusChristi.

*Holidays Related to Christmas:*

*Other Ecclesiastical Feasts:*

*CHZurich - Public Holidays:*

*GBLondon - Public Holidays:*
GBEarlyMayBankHoliday, GBSpringBankHoliday GBSummerBankHoliday, GBNewYearsEve. (The deprecated GBMayDay and GBBankHoliday are still available but strongly discouraged. Instead, use GBEarlyMayBankHoliday and GBSpringBankHoliday, respectively)

*DEFrankfurt - Public Holidays:*
DEAscension, DECorpusChristi, DEGermanUnity, DEChristmasEve, DENewYearsEve.

*FRParis - Public Holidays:*
FRFetDeLaVictoire1945, FRAscension, FRBastilleDay, FRAssumptionVirginMary, FRAAllSaints, FRArmisticeDay.

*ITMilano - Public Holidays:*
ITEpiphany, ITLiberationDay, ITRepublicAnniversary, ITAssumptionOfVirginMary, ITAllSaints, ITWWIVictoryAnniversary, ITStAmrose, ITImmaculateConception.

*USNewYork/USChicago - Public Holidays:*
 holidayDate  


CAToronto/CAMontreal - Public Holidays:

JPYahoo/JPoSaka - Public Holidays:

Value

an object of class "timeDate"

Examples

## holiday -
# Dates for GoodFriday from 2000 until 2005:
holiday(2000:2005, "GoodFriday")
holiday(2000:2005, GoodFriday) # same (GoodFriday is a function)

# Good Friday and Easter
holiday(2000:2005, c("GoodFriday", "Easter"))
holiday(2000:2005, c(GoodFriday, Easter))

## Easter -

## GoodFriday -
GoodFriday(2000:2005)

---

<table>
<thead>
<tr>
<th>holidayDate</th>
<th>Public and ecclesiastical holidays</th>
</tr>
</thead>
</table>

Description

A collection of functions giving holiday dates in the G7 countries and Switzerland.
Usage

Septuagesima(year = getRmetricsOptions("currentYear"))
Quinquagesima(year = getRmetricsOptions("currentYear"))
AshWednesday(year = getRmetricsOptions("currentYear"))
PalmSunday(year = getRmetricsOptions("currentYear"))
GoodFriday(year = getRmetricsOptions("currentYear"))
EasterSunday(year = getRmetricsOptions("currentYear"))
EasterMonday(year = getRmetricsOptions("currentYear"))
RogationSunday(year = getRmetricsOptions("currentYear"))
Ascension(year = getRmetricsOptions("currentYear"))
Pentecost(year = getRmetricsOptions("currentYear"))
PentecostMonday(year = getRmetricsOptions("currentYear"))
TrinitySunday(year = getRmetricsOptions("currentYear"))
CorpusChristi(year = getRmetricsOptions("currentYear"))
ChristTheKing(year = getRmetricsOptions("currentYear"))
Advent1st(year = getRmetricsOptions("currentYear"))
Advent2nd(year = getRmetricsOptions("currentYear"))
Advent3rd(year = getRmetricsOptions("currentYear"))
Advent4th(year = getRmetricsOptions("currentYear"))
ChristmasEve(year = getRmetricsOptions("currentYear"))
ChristmasDay(year = getRmetricsOptions("currentYear"))
BoxingDay(year = getRmetricsOptions("currentYear"))
NewYearsDay(year = getRmetricsOptions("currentYear"))
SolemnityOfMary(year = getRmetricsOptions("currentYear"))
Epiphany(year = getRmetricsOptions("currentYear"))
PresentationOfTheLord(year = getRmetricsOptions("currentYear"))
Annunciation(year = getRmetricsOptions("currentYear"))
TransfigurationOfTheLord(year = getRmetricsOptions("currentYear"))
AssumptionOfMary(year = getRmetricsOptions("currentYear"))
BirthOfVirginMary(year = getRmetricsOptions("currentYear"))
CelebrationOfHolyCross(year = getRmetricsOptions("currentYear"))
MassOfTheArchangels(year = getRmetricsOptions("currentYear"))
AllSaints(year = getRmetricsOptions("currentYear"))
AllSouls(year = getRmetricsOptions("currentYear"))
LaborDay(year = getRmetricsOptions("currentYear"))
CHBerchtoldDay(year = getRmetricsOptions("currentYear"))
CHSechselaeuten(year = getRmetricsOptions("currentYear"))
CHAscension(year = getRmetricsOptions("currentYear"))
CHConfederationDay(year = getRmetricsOptions("currentYear"))
CHKnabenschiessen(year = getRmetricsOptions("currentYear"))

GBMayDay(year = getRmetricsOptions("currentYear"))
GBEarlyMayBankHoliday(year = getRmetricsOptions("currentYear"))

GBBankHoliday(year = getRmetricsOptions("currentYear")) # see note in details section
GBSpringBankHoliday(year = getRmetricsOptions("currentYear"))

GBSummerBankHoliday(year = getRmetricsOptions("currentYear"))
holidayDate

GBMilleniumDay(year = getRmetricsOptions("currentYear"))
DEAscension(year = getRmetricsOptions("currentYear"))
DECorpusChristi(year = getRmetricsOptions("currentYear"))
DEGermanUnity(year = getRmetricsOptions("currentYear"))
DEChristmasEve(year = getRmetricsOptions("currentYear"))
DENewYearsEve(year = getRmetricsOptions("currentYear"))
FRFetDeLaVictoire1945(year = getRmetricsOptions("currentYear"))
FRAscension(year = getRmetricsOptions("currentYear"))
FRBastilleDay(year = getRmetricsOptions("currentYear"))
FRAssumptionVirginMary(year = getRmetricsOptions("currentYear"))
FRArmisticeDay(year = getRmetricsOptions("currentYear"))
ITEpiphany(year = getRmetricsOptions("currentYear"))
ITLiberationDay(year = getRmetricsOptions("currentYear"))
ITAssumptionOfVirginMary(year = getRmetricsOptions("currentYear"))
ITALIsants(year = getRmetricsOptions("currentYear"))
ITTStAmrose(year = getRmetricsOptions("currentYear"))
ITImmaculateConception(year = getRmetricsOptions("currentYear"))
USDedicationMemorialDay(year = getRmetricsOptions("currentYear"))
USPresidentsDay(year = getRmetricsOptions("currentYear"))
USNewYearsDay(year = getRmetricsOptions("currentYear"))
USInaugurationDay(year = getRmetricsOptions("currentYear"))
USMLKJsBirthday(year = getRmetricsOptions("currentYear"))
USLincolnsBirthday(year = getRmetricsOptions("currentYear"))
USWashingtonsBirthday(year = getRmetricsOptions("currentYear"))
USMemorialDay(year = getRmetricsOptions("currentYear"))
USIndependenceDay(year = getRmetricsOptions("currentYear"))
USLaborDay(year = getRmetricsOptions("currentYear"))
USColumbusDay(year = getRmetricsOptions("currentYear"))
USElectionDay(year = getRmetricsOptions("currentYear"))
USVeteransDay(year = getRmetricsOptions("currentYear"))
USThanksgivingDay(year = getRmetricsOptions("currentYear"))
USChristmasDay(year = getRmetricsOptions("currentYear"))
USCPulaskisBirthday(year = getRmetricsOptions("currentYear"))
USGoodFriday(year = getRmetricsOptions("currentYear"))
USJuneteenthNationalIndependenceDay(year = getRmetricsOptions("currentYear"))
CAVictoriaDay(year = getRmetricsOptions("currentYear"))
CACAmaDay(year = getRmetricsOptions("currentYear"))
CACivicProvincialHoliday(year = getRmetricsOptions("currentYear"))
CALabourDay(year = getRmetricsOptions("currentYear"))
CAThanksgivingDay(year = getRmetricsOptions("currentYear"))
CARemembranceDay(year = getRmetricsOptions("currentYear"))
JPVernalEquinox(year = getRmetricsOptions("currentYear"))
JPNYDay(year = getRmetricsOptions("currentYear"))
JPGanton(year = getRmetricsOptions("currentYear"))
JPBankHolidayJan2(year = getRmetricsOptions("currentYear"))
JPBankHolidayJan3(year = getRmetricsOptions("currentYear"))
JPComingOfAgeDay(year = getRmetricsOptions("currentYear"))
holidayDate

JPSeijinNoHi(year = getRmetricsOptions("currentYear"))
JPNatFoundationDay(year = getRmetricsOptions("currentYear"))
JPKenkokuKinenNoHi(year = getRmetricsOptions("currentYear"))
JPGreeneryDay(year = getRmetricsOptions("currentYear"))
JPMidoriNoHi(year = getRmetricsOptions("currentYear"))
JPConstitutionDay(year = getRmetricsOptions("currentYear"))
JKenpouKinenBi(year = getRmetricsOptions("currentYear"))
JPNationHoliday(year = getRmetricsOptions("currentYear"))
JKokuminNoKyujitu(year = getRmetricsOptions("currentYear"))
JPCustomersDay(year = getRmetricsOptions("currentYear"))
JPKodomoNoHi(year = getRmetricsOptions("currentYear"))
JPMarineDay(year = getRmetricsOptions("currentYear"))
JPShuubunNoHi(year = getRmetricsOptions("currentYear"))
JPRussetForTheAgedDay(year = getRmetricsOptions("currentYear"))
JPKineoUriNoHi(year = getRmetricsOptions("currentYear"))
JPSummerEquinox(year = getRmetricsOptions("currentYear"))
JPRespectForTheAgedDay(year = getRmetricsOptions("currentYear"))
JPKinrouKanshaNoHi(year = getRmetricsOptions("currentYear"))
JPAutumnalEquinox(year = getRmetricsOptions("currentYear"))
JPAutumnalEquinox(year = getRmetricsOptions("currentYear"))
JPKindouNoHi(year = getRmetricsOptions("currentYear"))
JPBankHolidayDec31(year = getRmetricsOptions("currentYear"))

Arguments

year

an integer value or vector of year numbers including the century. These are integers of the form CCYY, e.g. 2000.

Details

The deprecated GBMayDay and GBBankHoliday are still available but strongly discouraged. Instead, use GBEarlyMayBankHoliday and GBSpringBankHoliday, respectively.

Value

the date of the requested holiday as a "timeDate" object

Examples

## CHSechselaeuten -
# Sechselaeuten a half Day Bank Holiday in Switzerland
CHSechselaeuten(getRmetricsOptions("currentYear"))

## German Unification Day:
DEGermanUnity(getRmetricsOptions("currentYear"))
holidayLONDON

London Bank Holidays

Description
Returns bank holidays in London.

Usage
holidayLONDON(year = getRmetricsOptions("currentYear"))

Arguments
year an integer value or vector of years, formatted as YYYY.

Details
There are 8 bank holidays in Britain every year: New Year’s Day, Good Friday, Easter Monday, Spring (May), Last Monday of May, End of Summer (Last Monday) August, Christmas Eve, Christmas Day.

Value
an object of class "timeDate".

Author(s)
Function contributed by Menon Murali, amended by Georgi N. Boshnakov

Examples
## holidayLONDON

holidayLONDON()

holidayLONDON(2008:2010)

holidayNERC

NERC holiday calendar

Description
Returns a holiday calendar for NERC, the North American Reliability Council.

Usage

holidayNERC(year = getRmetricsOptions("currentYear"), FinCenter = "Eastern")
Arguments

year an integer value or vector of years, formatted as YYYY.
FinCenter a character value, the name of the financial center to use.

Value

an object of class "timeDate"

Author(s)

Joe W. Byers

References

http://www.nerc.com/~oc/offpeaks.html

Examples

## holidayNERC -
holidayNERC()
holidayNERC(2008:2010)

<table>
<thead>
<tr>
<th>holidayNYSE</th>
<th>NYSE holiday calendar</th>
</tr>
</thead>
</table>

Description

Returns a holiday (closing days) calendar for the New York Stock Exchange.

Usage

holidayNYSE(year = getRmetricsOptions("currentYear"),
       type = c("", "standard", "special"))

Arguments

year an integer value or vector of years, formatted as YYYY.

Arguments

year an integer value or vector of years, formatted as YYYY.
type what to include, a character string. The default is to return all closing days (holidays and specials). "standard" requests only closings associated with the standard public holidays, "special" gives the special closings only.

Details

holidayNYSE generates a list of the closing days of the exchange for the requested years.
The default is to return all closing days (holidays and specials). type = "standard" requests only closings associated with the standard public holidays, type = "special" gives the special closings only.
Value

an object of class "timeDate"

Note

The list of closing days returned by holidayNYSE was changed in timeDate version 4021.105, in that previously it did not include special closing days. This was perceived by some users as buggy. Also, the intent by the authors of the package seems to have been for it to return all closing days. Indeed, the default for isisBizday() is to drop weekends and days returned by holidayNYSE.

Argument type was also included in version 4021.105. The old behaviour can be obtained by using type = "standard".

The default for argument type is currently the empty string, since I couldn’t come up with another string that would be universally easy to remember. Suggestions are welcome but a change will be only feasible if they come soon.

Author(s)

Diethelm Wuertz (original author); Yohan Chalabi improved speed and handling of time zone; Georgi N. Boshnakov added the special closings and argument 'type'.

Examples

```r
## holidayNYSE -
holidayNYSE() ## current year
holidayNYSE(2008:2010)

## January 2, 2007 was a memorial day for president G.R. Ford,
## not a regular public holiday
holidayNYSE(2007)
holidayNYSE(2007, type = "standard")
holidayNYSE(2007, type = "special")
```

Description

Returns a holiday calendar for the Toronto Stock Exchange.

Usage

```r
holidayTSX(year = getRmetricsOptions("currentYear"))
```

Arguments

- `year` an integer value or vector of years, formatted as YYYY.
Description

Returns a holiday calendar for Zurich.

Usage

holidayZURICH(year = getRmetricsOptions("currentYear"))

Arguments

year an integer value or vector of years, formatted as YYYY.

Details


Value

an object of class "timeDate"

Examples

## holidayZURICH -
holidayZURICH()
holidayZURICH(2008:2010)
is.na-methods

Methods for "is.na"

Description

is.na methods for "timeDate" objects.

Examples

# Create a timeCalendar sequence
(td <- timeCalendar())
is.na(td)

# insert NA's
is.na(td) <- 2:3
td

# test of NA's
is.na(td)

isBizday

Check if dates are business or holidays

Description

Tests if a date is a business day or not.

Usage

isBizday(x, holidays = holidayNYSE(), wday = 1:5)
isHoliday(x, holidays = holidayNYSE(), wday = 1:5)

Arguments

x an object of class "timeDate".

holidays holiday dates from a holiday calendar. An object of class "timeDate".

wday Specify which days should be considered as weekdays. By default from Mondays to Fridays.

Details

Returns a logical vector of the same length as x indicating if a date is a business day, or a holiday, respectively.

Value

a logical vector of the same length as x
Examples

```r
## Dates in April, currentYear:
currentYear = getRmetricsOptions("currentYear")
tS = timeSequence(
    from = paste(currentYear, "-03-01", sep = ""),
    to = paste(currentYear, "-04-30", sep = ")
)tS

## Subset Business Days at NYSE:
holidayNYSE()
isBizday(tS, holidayNYSE())
tS[isBizday(tS, holidayNYSE())]
```

---

### isRegular

**Checks if a date/time vector is regular**

Checks if a date/time vector is regular. i.e. if it is a daily, a monthly, or a quarterly date/time vector. If the date/time vector is regular the frequency can determined calling the function frequency.

#### Usage

```r
## S4 method for signature 'timeDate'
isDaily(x)
## S4 method for signature 'timeDate'
isMonthly(x)
## S4 method for signature 'timeDate'
isQuarterly(x)

## S4 method for signature 'timeDate'
isRegular(x)

## S4 method for signature 'timeDate'
frequency(x, ...)
```

#### Arguments

- `x` an object of class "timeDate".
- `...` arguments to be passed.

#### Details

A date/time vector is defined as daily if the vector has not more than one date/time stamp per day.
A date/time vector is defined as monthly if the vector has not more than one date/time stamp per month.
A date/time vector is defined as quarterly if the vector has not more than one date/time stamp per quarter.

A monthly date/time vector is also a daily vector, a quarterly date/time vector is also a monthly vector.

A regular date/time vector is either a monthly or a quarterly vector.

NOT yet implemented is the case of weekly vectors.

Value

The is* functions return TRUE or FALSE depending on whether the date/time vector fulfills the condition or not.

The function frequency returns in general 1, for quarterly date/time vectors 4, and for monthly vectors 12.

Examples

```r
## None
```

### isWeekday

#### Description

Tests if a date is a weekday or not.

#### Usage

```r
isWeekday(x, wday = 1:5)
```

#### Arguments

- `x`: an object of class "timeDate".
- `wday`: Specify which days should be considered as weekdays. By default from Mondays to Fridays.

#### Value

A logical vector indicating if a date is a weekday or a weekend day.
Examples

```r
# Dates in April, currentYear:
currentYear = getRmetricsOptions("currentYear")
tS = timeSequence(
  from = paste(currentYear, "-03-01", sep = ""),
  to = paste(currentYear, "-04-30", sep = ")
)tS

# Subset of Weekends:
isWeekend(tS)
tS[isWeekend(tS)]
```

julian

Julian counts and calendar atoms

Description

Returns Julian day counts, date/time atoms from a "timeDate" object, and extracts month atoms from a "timeDate" object.

Usage

```r
## S4 method for signature 'timeDate'
julian(x, origin = timeDate("1970-01-01"),
  units = c("auto", "secs", "mins", "hours", "days", "weeks"),
  zone = NULL, FinCenter = NULL, ...)

## S4 method for signature 'timeDate'
atoms(x, ...)

## S4 method for signature 'timeDate'
months(x, abbreviate = NULL)
```

Arguments

- `x`: an object of class "timeDate".
- `origin`: a length-one object inheriting from class "timeDate" setting the origin for the julian counter.
- `units`: a character string denoting the date/time units in which the results are desired.
- `zone`: the time zone or financial center where the data were recorded.
- `FinCenter`: a character string with the location of the financial center named as "continent/city".
- `abbreviate`: currently not used.
- `...`: arguments passed to other methods.
Details

Generic functions to extract properties of "timeDate" objects. julian and months are generics from base R, while atoms is a generic defined in this package.

julian extracts the number of days since origin (can be fractional), see also julian.

atoms extracts the calendar atoms from a "timeDate" object, i.e., the year, month, day, and optionally, hour, minute and second. The result is a data frame with the financial center in attribute "control".

months extracts the months as integers from 1 to 12, unlike base::months which returns the names of the months.

Value

for julian, a difftime object;

for atoms, a data.frame with attribute "control" containing the financial center of the input vector x. The data frame has the following components:

Y year,
m month,
d day,
H hour,
M minute,
S second;

for months, a numeric vector with attribute "control" containing the financial center.

See Also

the base R functions julian, difftime, months;
dayOfWeek, dayOfYear

Examples

## julian -
  tC = timeCalendar(2022)
  julian(tC)[1:3]

## atoms -
  atoms(tC)

## months -
  months(tC)
**Description**

Generic function for computation of kurtosis. The methods defined in package `timeDate` are described here.

**Usage**

```r
kurtosis(x, ...)  
## Default S3 method:  
kurtosis(x, na.rm = FALSE,  
       method = c("excess", "moment", "fisher"), ...)  
## S3 method for class 'data.frame'  
kurtosis(x, na.rm = FALSE,  
       method = c("excess", "moment", "fisher"), ...)  
## S3 method for class 'POSIXct'  
kurtosis(x, ...)  
## S3 method for class 'POSIXlt'  
kurtosis(x, ...)  
```

**Arguments**

- `x` a numeric vector or object.
- `na.rm` a logical. Should missing values be removed?
- `method` a character string, the method of computation, see section ‘Details’.
- `...` arguments to be passed.

**Details**

`kurtosis` is an S3 generic function. This page describes the methods defined in package `timeDate`. Argument "method" can be one of "moment", "fisher", or "excess". If "excess" is selected, then the value of the kurtosis is computed by the "moment" method and a value of 3 will be subtracted. The "moment" method is based on the definitions of kurtosis for distributions and this method should be used when resampling (bootstrap or jackknife). The "fisher" method corresponds to the usual "unbiased" definition of sample variance, although in the case of kurtosis exact unbiasedness is not possible.

If `x` is numeric the kurtosis is computed according to the description given for argument `method`. A logical vector is treated as a vector of 1’s and 0’s.
The `data.frame` method applies `kurtosis` recursively to each column. The `POSIXlt` method computes the kurtosis of the underlying numerical representation of the date/times. The method for `POSIXct` does the same after converting the argument to `POSIXlt`.

The default method returns `NA`, with a warning, if it can’t handle argument `x`.

**Value**

a numeric value or vector with attribute "method" indicating the method.

**See Also**

`skewness`

**Examples**

```r
## mean -
## var -
# Mean, Variance:
r = rnorm(100)
mean(r)
var(r)

## kurtosis -
kurtosis(r)

kurtosis(data.frame(r = r, r2 = r^2))
```

---

### length

**Description**

Returns the length of a "timeDate" object.

**Usage**

```r
## S3 method for class 'timeDate'
length(x)
```

**Arguments**

- `x` an object of class "timeDate".

**Value**

an integer of length 1
Examples

```r
## timCalendar -
  tC = timeCalendar()

## length -
  length(tC)
```

---

**listFinCenter**  
*List of financial centers*

Description

Lists supported financial centers.

Usage

```r
listFinCenter(pattern = ".*")
```

Arguments

- **pattern**: a pattern character string as required by the `grep` function. The default, ".*", gives all supported financial centers.

Details

The list returned by `listFinCenter` doesn’t contain all financial centers supported by `timeDate`. Rather it contains currently supported ‘standard names’ of time zones defined in the tz (a.k.a. Zone-info) database. Names supported by previous versions of `timeDate` are recognised, even though they are not in the list.

Value

a character vector listing the financial centers whose names match `pattern`.

See Also

`rulesFinCenter` for the daylight saving rules

Examples

```r
## myFinCenter - the global setting currently used:
  getRmetricsOptions("myFinCenter")

## Other Financial Centers:
  listFinCenter("Asia/")
  listFinCenter("^[A]")  # all beginning with "A"
  listFinCenter("^[A]*")  # *not* beginning with "A"
  listFinCenter(".*L")  # cities with L*
```
stopifnot(identical(sort(listFinCenter()), ## 'A' and 'not A' == everything: sort(union(listFinCenter("^A"),
                      listFinCenter("[^A]")))))

Description

Returns a list of holidays.

Usage

listHolidays(pattern = ".*"

Arguments

pattern a pattern character string as required by the grep function.

Details

Returns a character vector containing the names of supported holidays matching pattern. The default is to return all holidays.

Value

a character vector

Examples

## listHolidays -

# All Holidays:
listHolidays()

# Local Swiss Holidays:
listHolidays("CH")
**Description**

Corrects "timeDate" objects if they do not fulfill the ISO8601 midnight standard.

midnightStandard2() relies on `strptime` wherever possible, and there simply returns `as.POSIXct(strptime(charvec, format, tz = "GMT"))`.

**Usage**

```r
midnightStandard (charvec, format)
midnightStandard2(charvec, format)
```

**Arguments**

- `charvec` a character string or vector of dates and times.
- `format` a string, the format specification of the input character vector.

**Value**

midnightStandard returns a character and midnightStandard2 a `POSIXct` object.

**Examples**

```r
ch <- "2007-12-31 24:00"
midnightStandard(ch)
(mid2 <- midnightStandard2(ch))
class(mid2)
```

---

**myFinCenter**

**Description**

A character string with the name of my financial center.

**Note**

Can be modified by the user to his/her own or any other financial center. The default is "GMT". To list all supported financial centers use the function `listFinCenter`.

**See Also**

`listFinCenter`
myUnits

Examples

## myFinCenter - the global setting currently used:
getRmetricsOptions("myFinCenter")

## Change to another Financial center:
# setRmetricsOptions(myFinCenter = "Zurich")

## Do not care about DST ...  
# setRmetricsOptions(myFinCenter = "GMT")

---

myUnits | Frequency of date/time units

---

Description

A variable with the frequency of date/units.

Value

the date/time units, a character value, yy default "days"

Examples

## myUnits -
getRmetricsOptions("myUnits")

---

names-methods | The names of a 'timeDate' object

---

Description

Functions to get or set the names of a "timeDate" object.

Usage

## S4 method for signature 'timeDate'
names(x)

## S4 replacement method for signature 'timeDate'
names(x) <- value

Arguments

x an object of class "timeDate".

value a character vector of up to the same length as ‘x’, or ‘NULL’.
Examples

```r
td <- timeCalendar()
names(td) <- LETTERS[seq_along(td)]
td
```

### nDay

#### n-th n-day dates

**Description**

Computes the date for the n-th or last occurrence of an n-day in year/month.

**Usage**

```r
timeNthNdayInMonth(charvec, nday = 1, nth = 1, format = "%Y-%m-%d", zone = "", FinCenter = "")
timeLastNdayInMonth(charvec, nday = 1, format = "%Y-%m-%d", zone = "", FinCenter = "")
```

**Arguments**

- `charvec`: a character vector of dates and times.
- `nday`: an integer vector with entries ranging from 0 (Sunday) to 6 (Saturday).
- `nth`: an integer vector numbering the n-th occurrence.
- `format`: the format specification of the input character vector.
- `zone`: the time zone or financial center where the data were recorded.
- `FinCenter`: a character with the location of the financial center named as "continent/city".

**Details**

- `timeNthNdayInMonth` returns the nth occurrence of a n-day (nth = 1,...,5) in year, month.
- `timeLastNdayInMonth` returns the last nday in year, month.

**Value**

an object of class "timeDate"

**Examples**

```r
## timeNthNdayInMonth -
# What date is the second Monday in April 2004 ?
timeNthNdayInMonth("2004-04-01", 1, 2)

## timeLastNdayInMonth -
# What date has the last Tuesday in May, 1996 ?
timeLastNdayInMonth("1996-05-01", 2)
```
onOrAfter  

**On-or-after/before dates**

**Description**

Compute the date that is a "on-or-after" or "on-or-before" n-day.

**Usage**

```r
timeNdayOnOrAfter(charvec, nday = 1, format = "%Y-%m-%d",
                  zone = "", FinCenter = "")

timeNdayOnOrBefore(charvec, nday = 1, format = "%Y-%m-%d",
                   zone = "", FinCenter = "")
```

**Arguments**

- **charvec**: a character vector of dates and times.
- **nday**: an integer vector with entries ranging from 0 (Sunday) to 6 (Saturday).
- **format**: the format specification of the input character vector.
- **zone**: the time zone or financial center where the data were recorded.
- **FinCenter**: a character with the location of the financial center named as "continent/city".

**Details**

`timeNdayOnOrAfter` returns the date in the specified month that is a n-day (e.g. Sunday) on or after the given date. Month and date are given through argument `charvec`.

The function `timeNdayOnOrBefore` returns the date that is a n-day on or before the given date.

**Value**

an object of class "timeDate"

**Examples**

```r
## Date as character String:
charvec = "2006-04-16"

## timeNdayOnOrAfter
# What date has the first Monday on or after March 15, 1986 ?
timeNdayOnOrAfter("1986-03-15", 1)

## timeNdayOnOrBefore
# What date has Friday on or before April 22, 1977 ?
timeNdayOnOrBefore("1986-03-15", 5)
```
Description

Returns start and end dates for rolling periods.

Usage

```r
periods(x, period = "12m", by = "1m", offset = "0d")
periodicallyRolling(x, period = "52w", by = "4w", offset = "0d")
monthlyRolling(x, period = "12m", by = "1m")
```

Arguments

- `x` an object of class `timeDate`.
- `period` a span string, consisting of a length integer and a unit value, e.g. "52w" for 52 weeks.
- `by` a span string, consisting of a length integer and a unit value, e.g. "4w" for 4 weeks.
- `offset` a span string, consisting of a length integer and a unit value, e.g. "0d" for no offset.

Details

Periodically Rolling - Allowed unit values are "m" for 4 weeks, "w" for weeks, "d" for days, "H" for hours, "M" for minutes, and "S" for seconds.

Monthly Calendar Rolling - The only allowed allowed unit value is "m" for monthly periods. Express a quarterly period by "3m", a semester by "6m", a year by "12m" etc.

Examples

```r
## Create Time Sequence -
x <- timeSequence(from = "2001-01-01", to = "2009-01-01", by = "day")

## Generate Periods -
periods(x, "12m", "1m")
periods(x, "52w", "4w")

## Roll Periodically -
periodicallyRolling(x)

## Roll Monthly -
monthlyRolling(x)
```
Description

Plot methods for "timeDate" objects.

Usage

## S4 method for signature 'timeDate'
plot(x, y, ...)
## S4 method for signature 'timeDate'
lines(x, y, ...)
## S4 method for signature 'timeDate'
points(x, y, ...)

axis.timeDate(side, x, at, format = NULL, labels = TRUE, ...)

## S3 method for class 'timeDate'
pretty(x, n=5, min.n=n%/%3, shrink.sml=0.75,
       high.u.bias=1.5, u5.bias=0.5+1.5*high.u.bias,
       eps.correct=0, ...)

Arguments

x, y, at an object of class timeDate.
side an integer specifying which side of the plot the axis is to be drawn on. The axis is placed as follows: 1=below, 2=left, 3=above and 4=right.
format a POSIX format string, e.g. "%Y-%m-%d".
labels either a logical value specifying whether annotations are to be made at the tickmarks, or a vector of character strings to be placed at the tickpoints.
n an integer giving the desired number of intervals.
min.n a nonnegative integer giving the minimal number of intervals.
shrink.sml a positive numeric by a which a default scale is shrunk in the case when range(x) is very small.
high.u.bias a non-negative numeric, typically > 1. Larger high.u.bias values favor larger units.
u5.bias a non-negative numeric multiplier favoring factor 5 over 2.
eps.correct an integer code, one of 0,1,2. If non-0, a correction is made at the boundaries.
... arguments passed to other methods.

Value

returns a summary report of the details of a "timeDate" object. This includes the starting and end date, the number of dates the format and the financial center in use.
### Examples

```r
## timeCalendar -
x <- timeCalendar()
y <- rnorm(12)

## Plotting:
plot(x, y, type = "l")
points(x, y, pch = 19, col = "red")
plot(x, y, type = "l", xaxt = "n")
axis.timeDate(1, at = x[c(1, 3, 5, 7, 9, 11)], format = "%b")
axis.timeDate(1, at = x[12], format = "%Y")
```

---

### Description

Replicating "timeDate" objects.

### Usage

```
## S3 method for class 'timeDate'
rep(x, ...)  
```

### Arguments

- `x` - an object of class "timeDate".
- `...` - arguments passed to the method for 'POSIXct', `rep`.

### Value

an object of class "timeDate".

### Examples

```r
## rep -
ZUR = timeDate(dts, zone = "GMT", FinCenter = "Europe/Zurich")

rep(ZUR[2], times = 3)
rep(ZUR[2:3], times = 2)
```
**rev**

Reverse `timeDate` objects

### Description

Reverse a "timeDate" object.

### Usage

```r
## S3 method for class 'timeDate'
rev(x)
```

### Arguments

- **x**
  
an object of class "timeDate".

### Value

an object of class "timeDate"

### Examples

```r
ZUR = timeDate(dts, zone = "GMT", FinCenter = "Europe/Zurich")
ZUR
rev(ZUR)
```

---

**RmetricsOptions**

Rmetrics option settings

### Description

Allow the user to set and examine a variety of global options which affect the way in which Rmetrics functions compute and display their results.

### Usage

```r
setRmetricsOptions(...)
getRmetricsOption(x, unset = "")
```

### Arguments

- **unset**
  
a character string holding the return value is x is not set.

- **x**
  
a character string holding an option name.

- **...**
  
any options can be defined, using `name = value` or by passing a list of such tagged values.
Rounding and truncating 'timeDate' objects

Description

Rounds and truncates objects of class 'timeDate'.

Usage

```r
## S3 method for class 'timeDate'
round(x, digits = c("days", "hours", "mins"))

## S3 method for class 'timeDate'
trunc(x, units = c("days", "hours", "mins"), ...)
```

Arguments

- `digits`, `units` a character string denoting the date/time units in which the results are desired.
- `x` an object of class "timeDate".
- `...` arguments passed to other methods.

Details

The two functions `round` and `trunc` allow to round or to truncate "timeDate" objects to the specified unit and return them as "timeDate" objects.

There is an inconsistency in that `round` uses `digits` as argument and not `units`.

Value

an object of class "timeDate"

Examples

```r
## round -
## truncate -
```
rulesFinCenter

**Description**
Returns DST rules for a financial center.

**Usage**
```r
erulesFinCenter(FinCenter = "")
```

**Arguments**
- `FinCenter` a character string with the location of the financial center named as "continent/city".

**Details**
The function `rulesFinCenter` lists the daylight saving rules for a selected financial center.
There is no dependency on the POSIX implementation of your operating system because `timeDate` comes with a database containing the necessary time zone and day light saving time information.

**Value**
a list of time zones and DST rules available in the database

**See Also**
- `listFinCenter` for a list of the available financial centers

**Examples**
```r
## rulesFinCenter -
rulesFinCenter("Zurich")
```

---

**sample**

**Resampling 'timeDate' objects**

**Description**
Resamples a "timeDate" object.

**Value**
an object of class "timeDate"
Examples

## c -
# Create Character Vectors:
dts
tms = c("23:12:55", "10:34:02", "08:30:00", "11:18:23")
tms

## "+/-" -
# Add One Day to a Given timeDate Object:
GMT = timeDate(dts, zone = "GMT", FinCenter = "GMT")
GMT
ZUR = timeDate(dts, zone = "GMT", FinCenter = "Europe/Zurich")
ZUR

## c -
# Concatenate and Replicate timeDate Objects:
c(GMT[1:2], ZUR[1:2])
c(ZUR[1:2], GMT[1:2])

## rep -
rep(ZUR[2], times = 3)
rep(ZUR[2:3], times = 2)

Description

Show methods for "timeDate" objects.

Methods

object = "ANY"  Generic function.

object = "timeDate"  Print function for objects of class "timeDate".

Examples

## print | show -
print(timeCalendar())
skewness

skewness  Skewness

Description

Functions to compute skewness.

Usage

skewness(x, ...)

## Default S3 method:
skewness(x, na.rm = FALSE, method = c("moment", "fisher"), ...)

## S3 method for class 'data.frame'
skewness(x, na.rm = FALSE, method = c("moment", "fisher"), ...)

## S3 method for class 'POSIXct'
skewness(x, ...)

## S3 method for class 'POSIXlt'
skewness(x, ...)

Arguments

x a numeric vector or object.
na.rm a logical. Should missing values be removed?
method a character string, the method of computation, see section ‘Details’.
... arguments to be passed.

Details

Argument method can be one of "moment" or "fisher". The "moment" method is based on the definitions of skewness for distributions and this should be used when resampling (bootstrap or jackknife). The "fisher" method correspond to the usual "unbiased" definition of sample variance, although in the case of skewness exact unbiasedness is not possible.

Value

a numeric value or vector with attribute "method" indicating the method.

See Also

kurtosis
Examples

```r
## mean -
## var -
# Mean, Variance:
r = rnorm(100)
mean(r)
var(r)

## skewness -
skewness(r)
```
## c -

# Concatenate and Replicate timeDate Objects:
c(GMT[1:2], ZUR[1:2])
c(ZUR[1:2], GMT[1:2])

## rep -

rep(ZUR[2], times = 3)
rep(ZUR[2:3], times = 2)

---

### start

#### Terminal times and range

**Description**

Extracts the time when the first or last observation was taken, or computes the range of the dates in a "timeDate" object.

**Usage**

```r
## S3 method for class 'timeDate'
start(x, ...)
```

```r
## S3 method for class 'timeDate'
end(x, ...)
```

```r
## S3 method for class 'timeDate'
min(..., na.rm = FALSE)
```

```r
## S3 method for class 'timeDate'
max(..., na.rm = FALSE)
```

```r
## S3 method for class 'timeDate'
range(..., na.rm = FALSE)
```

**Arguments**

- `x`: an object of class "timeDate".
- `...`: ignored by `start` and `end`; a 'timeDate' object for `min`, `max`, and `range`.
- `na.rm`: not used.

**Details**

Conceptually, the "timeDate" object is sorted before the computations. In particular, `start` is not necessarily the first element of the object and similarly for the other functions.

`min` and `max` are equivalent to `start` and `end`, respectively.

`range` returns the earlies and the latest times in a "timeDate" object. The remaining functions return only one of them, as suggested by their names.
Value

an object of class "timeDate"

Examples

```r
## timeCalendar -
# Random Calendar Dates:

tr = sample(timeCalendar())
sort(tr)
tr

## start | end -
start(tr)
end(tr)

## The First and Last Time Stamp:
tr[1]
tr[length(tr)]
rev(tr)[1]

## The Range:
c(start(tr), end(tr))
range(tr)
```

---

subset

Subsetting a 'timeDate' object

Description

Extracts or replaces subsets from "timeDate" objects.

Value

an object of class "timeDate".

Examples

```r
## timeCalendar -
tS = timeCalendar()

## [ -
# Subsetting Second Quarter:
tS[4:6]

## [<- -
# Replacing:
```
## Summary method

### Description

Summarizes details of a "timeDate" object.

### Usage

```r
## S3 method for class 'timeDate'
summary(object, ...)
```

### Arguments

- `object`: an object of class "timeDate".
- `...`: arguments passed to other methods.

### Details

Creates a summary report of the details of a "timeDate" object. This includes the starting and end date, the number of dates the format and the financial center in use.

### Value

Currently the function just prints the report and returns invisibly the object.

**TODO:** The return value should not be relied upon since it is inconsistent with the way other methods for `summary` work. They create an object with a print method and returned the object, which is typically printed but can also be assigned.

### Examples

```r
## summary -
tC = timeCalendar()
summary(tC)
```

## System time as 'timeDate' object

### Description

Returns the system time as an object of class "timeDate".

### Usage

```r
Sys.timeDate(FinCenter = "")
```
Arguments

FinCenter a character string with the location of the financial center named as "continent/city".

Value

a "timeDate" object

Examples

```r
## Not run:
## direct
Sys.timeDate()

# Local Time in Zurich
Sys.timeDate(FinCenter = "Zurich")

## transformed from "POSIX(c)t" with timeDate()
timeDate(Sys.time())

# Local Time in Zurich
timeDate(Sys.time(), FinCenter = "Zurich")

## End(Not run)
```

timeCalendar

'timeDate' from calendar atoms

Description

Create a "timeDate" object from calendar atoms.

Usage

```r
timeCalendar(y = getRmetricsOptions("currentYear"), m = 1:12, d = 1,
             h = 0, min = 0, s = 0,
             zone = "", FinCenter = "")
```

Arguments

- `y, m, d` calendar years (e.g. 1997), defaults are 1960, calendar months (1-12), defaults are 1, and calendar days (1-31), defaults are 1,
- `h, min, s` hours of the days (0-23), defaults are 0, minutes of the days (0-59), defaults are 0, and seconds of the days (0-59), defaults are 0.
- `zone` a character string, denoting the time zone or financial center where the data were recorded.
- `FinCenter` a character with the location of the financial center named as "continent/city".
Value

an object of class "timeDate"

Examples

## timeCalendar -

```
# Current Year:
getRmetricsOptions("currentYear")

# 12 months of current year
timeCalendar()

timeCalendar(m = c(9, 1, 8, 2), d = c(28, 15, 30, 9),

timeCalendar(m = c(9, 1, 8, 2), d = c(28, 15, 30, 9),

timeCalendar(h = c(9, 14), min = c(15, 23))
```

Description

Create a "timeDate" object from scratch from a character vector or other suitable objects.

Usage

```
timeDate(charvec, format = NULL, zone = "", FinCenter = "", ...)

## S4 method for signature 'character'
timeDate(charvec, format = NULL, zone = "", FinCenter = "",
          dst_gap = "+")

strptimeDate(x, format = whichFormat(x), tz = ")
```

Arguments

charvec a character string or vector of dates and times.
format the format specification of the input character vector.
tz a character with the location of the financial center named as "continent/city", or short "city".
zone the time zone or financial center where the data were recorded.
x a character string or vector of dates and times.
FinCenter a character with the location of the financial center named as "continent/city".
dst_gap  
a character string specifying what to do with non-existent times falling in a DST gap: add an hour ("+"), subtract an hour ("-"), set to NA ("NA"), or ignore ("""). When the ‘ignore’ option is used the code to check for this kind of faulty times is skipped and the result will be equivalent to "+" or "-" but which one is not defined. This could be useful when you are certain that there are no times in DST gaps or don’t care how they are dealt with.

Details

timeDate creates objects from class "timeDate" from character vectors, objects from several date/time classes, and other suitable objects. It is an S4 generic function and this page describes the methods defined in package timeDate, see section ‘Methods’.

Note that zone is the time zone of the input, while FinCenter is the ‘current’ time zone, typically but not necessarily where the code is run. To change one or both of these time zones of an existing "timeDate" object, call timeDate() on it, see the method for charvec = "timeDate" in section ‘Methods’.

strptimeDate is a wrapper of timeDate, suitable when zone and FinCenter are the same. It has the same arguments as strptime. If format is missing it tries to deduce it. If tz is missing it sets it to the value of the Rmetrics option "myFinCenter".

Value

an object of class "timeDate"

Methods

The following methods for timeDate are defined in package timeDate.

signature(charvec = "ANY")  Converts charvec to character and calls timeDate on the result.
signature(charvec = "character") ...
signature(charvec = "Date") ...
signature(charvec = "missing")  Returns the current time as "timeDate" object.
signature(charvec = "numeric") ...
signature(charvec = "POSIXt") ...
signature(charvec = "timeDate") Changes the time zone and/or financial center of charvec to the requested ones. If zone is missing or equal to the empty string, just changes the financial center.

Examples

## timeDate -

# Character Vector Strings:
tms = c( "23:12:55", "10:34:02", "08:30:00", "11:18:23")

...
timeDate-class

Class "timeDate"

Description

Class "timeDate" represents date and time objects.

Details

For the management of chronological objects under R three concepts are available: The first is the implementation of date and time in R’s chron package neglecting locals, time zones and day light...
saving times. This approach is in most cases appropriate for economic time series. The second approach, available in R's base package implements the POSIX standard to date and time objects, named "POSIXt".

Unfortunately, the representation of these objects is in some cases operating system dependent and especially under MS Windows several problems appeared over the time in the management of time zones and day light saving times. Rmetrics overcomes these difficulties with POSIX objects and introduce a new S4 class of "timeDate" objects which allow for powerful methods to represent dates and times in different financial centers around the world.

Many of the basic functionalities of these objects are in common with S-Plus' "timeDate" objects and thus many of your privately written functions for SPlus/FinMetrics may also be used within the R/Rmetrics environment.

A major difference is the time zone concept which is replaced by the "Financial Center" concept. The FinCenter character variable specifies where you are living and at which financial center you are working. With the variable myFinCenter you can overwrite the default setting with your personal settings. With the specification of the FinCenter your system knows what rules rules for day light saving times should be applied, what is your holiday calendar, what is your currency, what are your interest rate conventions. (Not all specifications are already implemented,) Many other aspects can be easily accessed when a financial center is named. So we can distinguish between Frankfurt and Zurich, which both belong to the same time zone, but differed in DST changes in the eighties and have different holiday calendars. Furthermore, since the underlying time refers to "GMT" and DST rules and all other information is available in local (ASCII) databases, we are sure, that R/Rmetrics delivers with such a date/time concept on every computer independent of the operating system in use, identical results.

Another important feature of the "timeDate" concept used here is the fact that we don't rely on American or European ways to write dates. We use consequently the ISO-8601 standard for date and time notations.

Generation of "timeDate" Objects

We have defined a "timeDate" class which is in many aspects similar to the S-Plus class with the same name, but has also some important advantageous differences. The S4 class has four Slots, the Data slot which holds date and time as 'POSIXct' objects in the standard ISO-8601 format, the Dim slot which gives the dimension of the data object (i.e. its length), the format specification slot and the FinCenter slot which holds the name of the financial center. By default this is the value "iso8601".

Three functions allow to generate date/time objects: "timeDate" from character vectors, timeCalendar from date and time atoms, and timeSequence from a "from/to" or from a "from/length" sequence specification. Note, time zone transformations are easily handled by by the "timeDate" functions which can also take "timeDate" and POSIXt objects as inputs, while transforming them between financial centers and/or time zones specified by the arguments zone and FinCenter. Finally the function Sys.timeDate returns current system time in form of a "timeDate" object.

Tests and Representation of timeDate Objects:

Rmetrics has implemented several methods to represent "timeDate" objects. For example, the print method returns the date/time in square "[]" brackets to distinguish the output from other date and time objects. On top of the date and time output the name of the FinCenter is printed. The summary method returns a printed report with information about the "timeDate" object. Finally,
the format methods allows to transform objects into a ISO conform formatted character strings.

Mathematical Operations:
Rmetrics supports methods to perform many mathematical operations. Included are methods to extract or to replace subsets from "timeDate" objects, to perform arithmetic "+" and "-" operations, to group Ops generic functions, to return suitably lagged and iterated differences diff, to return differences difftimeDate of two "timeDate" objects, to concatenate objects, to replicate objects, to round objects, to truncate objects using trunc, to extract the first or last entry of a vector, to sort the objects of the elements of a date/time vector, and to revert "timeDate" vector objects, among other functions.

Transformation of Objects:
Rmetrics has also functions to transform dat/time objects between different representations. Included are methods to transform "timeDate" objects to character strings, to data frames, to POSIXct or POSIXlt objects, to julian counts. One can extract date/time atoms from calendar dates, and the months atoms from a "timeDate" object.

Objects from the Class
Objects can be created by calls of the functions timeDate, timeSequence and timeCalendar, among others.

Slots
Data: Object of class "POSIXct": a vector of POSIXct dates and times always related to "GMT".
format: Object of class "character": a character string denoting the format specification of the input data character vector.
FinCenter: Object of class "character": a character string with the location of the financial center named as "continent/city", or just "city".

Methods
timeDate signature(charvec = "timeDate"): create objects from class "timeDate", see timeDate;
show signature(object = "timeDate"): prints an object of class "timeDate";
plot signature(x = "timeDate");
points signature(x = "timeDate");
lines signature(x = "timeDate");
abline signature(a = "ANY", b = "ANY", h = "ANY", v = "timeDate"): see plot-methods.
[ signature(x = "timeDate", i = "ANY", j = "missing");
[ signature(x = "timeDate", i = "character", j = "missing");
[ signature(x = "timeDate", i = "logical", j = "missing");
[ signature(x = "timeDate", i = "missing", j = "missing");
[ signature(x = "timeDate", i = "numeric", j = "missing"): take parts of a "timeDate" object, see subset.
finCenter signature(x = "timeDate"): see finCenter.

atoms signature(x = "timeDate"): see atoms.

months signature(x = "timeDate"): see months.

julian signature(x = "timeDate"): see julian.

align signature(x = "timeDate"): see align.

isDaily signature(x = "timeDate"): see isDaily.

isMonthly signature(x = "timeDate"): see isMonthly.

isQuarterly signature(x = "timeDate"): see isQuarterly.

isRegular signature(x = "timeDate"): see isRegular.

frequency signature(x = "timeDate"): see frequency.

is.na signature(x = "timeDate"): see is.na-methods.

sample signature(x = "timeDate"): see sample.

 Ops signature(e1 = "timeDate", e2 = "timeDate"): see Ops.

+ signature(e1 = "numeric", e2 = "timeDate"): see +.

+ signature(e1 = "timeDate", e2 = "numeric"): see +.

+ signature(e1 = "timeDate", e2 = "timeDate"): see +.

- signature(e1 = "numeric", e2 = "timeDate"): see -.

- signature(e1 = "timeDate", e2 = "numeric"): see -.

- signature(e1 = "timeDate", e2 = "timeDate"): see -. 

coerce signature(from = "ANY", to = "timeDate"): see coerce.

coerce signature(from = "Date", to = "timeDate"): see coerce.

coerce signature(from = "POSIXt", to = "timeDate"): see coerce.

coerce signature(from = "timeDate", to = "character"): see coerce.

coerce signature(from = "timeDate", to = "data.frame"): see coerce.

coerce signature(from = "timeDate", to = "Date"): see coerce.

coerce signature(from = "timeDate", to = "list"): see coerce.

coerce signature(from = "timeDate", to = "numeric"): see coerce.

coerce signature(from = "timeDate", to = "POSIXct"): see coerce.

coerce signature(from = "timeDate", to = "POSIXlt"): see coerce.

These are methods for as, to be used with the syntax as(from, to), where from is the object 
to be converted and to is the desired target class. Most conversions can also be done with 
specialised functions such as as.character and as.timeDate, see as.timeDate.

names signature(x = "timeDate"): see names.

names<- signature(x = "timeDate"): see names-methods.

dataPart signature(object = "timeDate"): see dataPart.

initialize signature(.Object = "timeDate"): see initialize.
Note

Originally, these functions were written for Rmetrics users using R and Rmetrics under Microsoft's Windows XP operating system where time zones, daylight saving times and holiday calendars are not or insufficiently supported.

The usage of the Ical Library and the introduction of the FinCenter concept was originally developed for R Version 1.5. The "timeDate" and timeSeries objects were added for R Version 1.8.1. Minor changes were made to adapt the functions for R Version 1.9.1. As a consequence, newer concepts like the Date objects were not yet considered and included in this collection of date and time concepts. With R Version 2.3.0 a major update has been made adding many new generic functions and renaming a few already existing functions, please be aware of this.

Note, the date/time conversion from an arbitrary time zone to GMT cannot be unique, since date/time objects appear twice during the hour when DST changes and the isdt flag was not recorded. A bookkeeping which takes care if DST is effective or not is not yet included. However, in most applications this is not necessary since the markets are closed on weekends, especially at times when DST usually changes. It is planned for the future to implement the DST supporting this facility.

The ISO-8601 midnight standard has been implemented. Note, that for example "2005-01-01 24:00:00" is accepted as a valid date/time string.

Also available is an automated format recognition, so the user does not have to specify the format string for the most common date/time formats.

Examples

```r
## Examples for Objects of class 'timeDate':

## timeDate -

# Sys.timeDate()       # direct
# timeDate(Sys.time()) # transformed from "POSIXct"

# # Local Time in Zurich
# timeDate(Sys.time(), FinCenter = "Zurich")

# Character Vector Strings:
dts
tms = c("23:12:55", "10:34:02", "08:30:00", "11:18:23")
tms

t1 <- timeDate(dts, format = "%Y-%m-%d", FinCenter = "GMT")
t1

stopifnot(identical(t1, timeDate(dts, FinC = "GMT"))) # auto-format

timeDate(dts, format = "%Y-%m-%d", FinCenter = "Europe/Zurich")

timeDate(paste(dts, tms), format = "%Y-%m-%d %H:%M:%S",
          zone = "GMT", FinCenter = "GMT")

timeDate(paste(dts, tms),
```
zone = "Europe/Zurich", FinCenter = "Europe/Zurich")

timeDate(paste(dts, tms), format = "%Y-%m-%d %H:%M:%S",
zone = "GMT", FinCenter = "Europe/Zurich")

## Non Standard Format:
timeDate(paste(20:31, "03.2005", sep="."), format = "%d.%m.%Y")

# Note, ISO and American Formats are Auto-Detected:
timeDate("2004-12-31", FinCenter = "GMT")
timeDate("12/11/2004", FinCenter = "GMT")
timeDate("1/31/2004") # auto-detect American format

## ... from POSIX?t, and Using NAs:
## lsec <- as.POSIXlt(.leap.seconds)
## lsec[c(2,4:6)] <- NA
## timeDate(lsec)

## dtms <- paste(dts,tms)
## dtms[2:3] <- NA
## timeDate(dtms, FinCenter = "Europe/Zurich") # but in GMT

## timeCalendar -

## getRmetricsOptions("currentYear")
## timeCalendar() # 12 months of current year

timeCalendar(2022) # 12 months of 2022
timeCalendar(y = c(1989, 2001, 2004, 1990),
   m = c(9, 1, 8, 2), d = c(28, 15, 30, 9), FinCenter = "GMT")
timeCalendar(y = c(1989, 2001, 2004, 1990),
   m = c(9, 1, 8, 2), d = c(28, 15, 30, 9), FinCenter = "Europe/Zurich")

## timeCalendar(h = c(9, 14), min = c(15, 23))
timeCalendar(2022, h = c(9, 14), min = c(15, 23))

## timeSequence -
timeSequence(from = "2004-03-12", to = "2004-04-11",
   format = "%Y-%m-%d", FinCenter = "GMT")
timeSequence(from = "2004-03-12", to = "2004-04-11",
   format = "%Y-%m-%d", FinCenter = "Europe/Zurich")

## print | summary | format -

tC = timeCalendar(2022)
print(tC)
summary(tC)
format(tC)
timeDateMathOps

Mathematical operations with "timeDate" objects

Description

Functions for mathematical and logical operations on "timeDate" objects.

The functions are:

- `Ops, timeDate` Group 'Ops' generic functions for "timeDate" objects,
- `+, timeDate` Performs arithmetic + operation on "timeDate" objects,
- `-, timeDate` Performs arithmetic - operation on "timeDate" objects.

Usage

## S4 method for signature 'timeDate, timeDate'

`Ops(e1, e2)`

Arguments

- `e1, e2` usually objects of class "timeDate", in the case of addition and subtraction `e2` may be of class numeric.

Value

- `Ops.timeDate` these are functions for mathematical operations. Group `Ops` are generic functions which manage mathematical operations.
- `+, timeDate`
- `- , timeDate`

The plus operator "+" performs arithmetic "+" operation on "timeDate" objects, and the minus operator "-" returns a `difftime` object if both arguments `e1` and `e2` are "timeDate" objects, or returns a "timeDate" object `e2` seconds earlier than `e1`.

Examples

## Create Character Vectors:

dts
tms = c("23:12:55", "10:34:02", "08:30:00", "11:18:23")
tms

## "+-" -

# Add One Day to a Given timeDate Object:
GMT = timeDate(dts, zone = "GMT", FinCenter = "GMT")
GMT
ZUR = timeDate(dts, zone = "GMT", FinCenter = "Europe/Zurich")
timeSequence

**Description**

Create a regularly spaced object of class "timeDate".

**Usage**

\[
\text{timeSequence}(\text{from}, \text{to} = \text{Sys.timeDate}(), \text{by}, \text{length.out} = \text{NULL}, \\
\text{format} = \text{NULL}, \text{zone} = \text{""}, \text{FinCenter} = \text{""})
\]

## S3 method for class 'timeDate'

seq(from, to, by, length.out = NULL, along.with = NULL, ...)

**Arguments**

- **from, to**: starting date, required, and end date, optional. If supplied, to must be after (later than) from.
- **by**:  
  - a character string, containing one of "sec", "min", "hour", "day", "week", "month" or "year". This can optionally be preceded by an integer and a space, or followed by "s".
  - character string "quarter" that is equivalent to "3 months".
  - A number, taken to be in seconds.
  - A object of class 'difftime'
  - character string "DSTday" gives a sequence taken at the same clock time every day. Note that on the days when the DST changes, the requested time may not exist or be ambiguous, see the examples.
- **length.out**: integer, optional. Desired length of the sequence, if specified "to" will be ignored.
- **along.with**: Take the length from the length of this argument.
- **format**: the format specification of the input character vector.
- **zone**: the time zone or financial center where the data were recorded.
- **FinCenter**: a character with the location of the financial center named as "continent/city".
- **...**: arguments passed to other methods.

**Value**

an object of class "timeDate"
Note

timeSequence() is a wrapper for the "timeDate" method of seq(), and that has been closely modeled after base R's POSIXt method, seq.POSIXt.

Examples

```r
## timeSequence -
## autodetection of format :
(t1 <- timeSequence(from = "2004-03-12", to = "2004-04-11"))

stopifnot( ## different formats even:
    identical(t1, timeSequence(from = "2004-03-12", to = "11-Apr-2004")),
    identical(t1, ## explicit format and FinCenter :
        timeSequence(from = "2004-03-12", to = "2004-04-11",
        format = "%Y-%m-%d", FinCenter = "GMT")))

## observe "switch to summer time":
timeSequence(from = "2004-03-26 05:00:00", to = "2004-04-02 05:00:00",
    zone = "Europe/Zurich", FinCenter = "Europe/Zurich")

## ensure fixed clock time:  
timeSequence(from = "2004-03-26 05:00:00", to = "2004-04-01 05:00:00",
    by = "DSTday", zone = "Europe/Zurich", FinCenter = "Europe/Zurich")

## on the day of DST change the time may not exist (notice 2004-03-28 00:00:00):
timeSequence(from = "2004-03-26 01:00:00", to = "2004-04-01 01:00:00",
    by = "DSTday", zone = "Europe/Zurich", FinCenter = "Europe/Zurich")
```

unique

Remove duplicated dates from 'timeDate' objects

Description

Remove duplicated dates from "timeDate" objects.

Usage

```r
## S3 method for class 'timeDate'
unique(x, ...)
```

Arguments

- `x`: an object of class "timeDate".
- `...`: arguments passed to other methods.

Value

an object of class "timeDate"
Examples

```r
## c -
# Create Character Vectors:
dts
tms = c( "23:12:55", "10:34:02", "08:30:00", "11:18:23")
tms

## "+/-" -
# Add One Day to a Given timeDate Object:
GMT = timeDate(dts, zone = "GMT", FinCenter = "GMT")
GMT
ZUR = timeDate(dts, zone = "GMT", FinCenter = "Europe/Zurich")
ZUR

## c -
# Concatenate and Replicate timeDate Objects:
c(GMT[1:2], ZUR[1:2])
c(ZUR[1:2], GMT[1:2])

## rep -
rep(ZUR[2], times = 3)
rep(ZUR[2:3], times = 2)
```

whichFormat

<table>
<thead>
<tr>
<th>Format recognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>whichFormat(charvec, silent = FALSE)</td>
</tr>
</tbody>
</table>

Description

Tries to recognize the date/time format.

Usage

`whichFormat(charvec, silent = FALSE)`

Arguments

charvec a character string or vector of dates and times.
silent a logical flag. Should a warning be printed if the format cannot be recognized?

Value

a format string

Examples

```r
## midnightStandard -
whichFormat("2007-12-31 24:00")
```
Description

Extract the subset of a "timeDate" object observed between two time stamps.

Usage

```r
## S3 method for class 'timeDate'
window(x, start, end, ...)
```

```r
## S3 method for class 'timeDate'
cut(x, from, to, ...)
```

Arguments

- `from, to` starting date, required, and end date, optional. If supplied to must be after from.
- `start, end` starting date, required, and end date, optional. If supplied to must be after from.
- `x` an object of class "timeDate".
- `...` arguments passed to other methods.

Value

an object of class "timeDate"

Note

The method for cut has been discouraged in the sources for a long time (with a recommendation to use window). It will be officially deprecated in the next release and later removed or replaced by a method that is consistent with the methods for cut in base R.

Examples

```r
## timeCalendar -
# Monthly Dates in Current Year:
tS = timeCalendar()
tS

## window -
# 2nd Quarter Window:
tS[4:6]
window(tS, tS[4], tS[6])
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