Package ‘bizdays’

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Title  Business Days Calculations and Utilities

Description  Business days calculations based on a list of holidays and nonworking weekdays. Quite useful for fixed income and derivatives pricing.

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Author  Wilson Freitas <wilson.freitas@gmail.com>

Maintainer  Wilson Freitas <wilson.freitas@gmail.com>

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Collate  'R-bizdays-package.r' 'calendar.R' 'adjust.date.R'
  'bizdays.options.R' 'bizseq.R' 'is.bizday.R' 'offset.R'
  'bizdiff.R' 'bizdays.R' 'create-calendars.R'
  'calendar-export.R' 'getdate.R' 'getbizdays.R'
  'load-buildin-calendars.R' 'zzz.R'

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Description

In many countries the standard approach to price derivatives and fixed income instruments involves the use of business days. In Brazil, for example, the great majority of financial instruments are priced on business days counting rules. Given that the use of business days is somehow vital to handle many tasks. That’s the reason why bizdays came up, to make these tasks easier. Excel’s NETWORKDAYS is fairly at hand and once you have a list of holidays it is quite easy to put your data into a spreadsheet and make things happen. bizdays brings that ease to R.

Although R’s users have similar feature in packages like RQuantLib and timeDate it doesn’t come for free. Users have to do some stackoverflow in order to get this task accomplished. bizdays is a tiny package dramatically focused on that simple task: support calculations involving business days for a given list of holidays.

bizdays was designed to work with all common date types and ISO formatted character strings and all methods have support for vectorized operations and handle the recycle rule.

Author(s)

Wilson Freitas
adjust.date

Adjusts the given dates to the next/previous business day

Description

Rolls the given date to the next or previous business day, unless it is a business day.

Usage

adjust.next(dates, cal)
following(dates, cal)
adjust.none(dates, cal)
modified.following(dates, cal)
adjust.previous(dates, cal)
preceding(dates, cal)
modified.preceding(dates, cal)

Arguments

dates: dates to be adjusted
cal: an instance of Calendar

Details

adjust.next and following return the next business day if the given date is not a business day.
adjust.previous and preceding are similar, but return the previous business day. modified.following rolls the given date to the next business day, unless it happens in the next month, in this case it returns the previous business day. modified.preceding is similar to modified.following, but rolls the given date to the previous business day.

Value

Date objects adjusted accordingly.

Date types accepted

The argument dates accepts Date objects and any object that returns a valid Date object when passed through as.Date, which include all POSIX* classes and character objects with ISO formatted dates.
Examples

adjust.next("2013-01-01", "Brazil/ANBIMA")
following("2013-01-01", "Brazil/ANBIMA")
modified.following("2016-01-31", "Brazil/ANBIMA")
adjust.previous("2013-01-01", "Brazil/ANBIMA")
preceding("2013-01-01", "Brazil/ANBIMA")
modified.preceding("2016-01-01", "Brazil/ANBIMA")

Description

Computes business days between two dates.

Returns the amount of business days between 2 dates taking into account the provided Calendar
(or bizdays.options$get("default.calendar")).

Usage

bizdays(from, to, cal)

Arguments

from the initial dates
to the final dates
cal the calendar’s name

Value

integer objects representing the amount of business days.

Date types accepted

The arguments from and to accept Date objects and any object that returns a valid Date object
when passed through as.Date, which include all POSIX* classes and character objects with ISO
formatted dates.

Recycle rule

These arguments handle the recycle rule so vectors of dates can be provided and once those vectors
differs in length the recycle rule is applied.

Date adjustment

from and to are adjusted when nonworking dates are provided. Since bizdays function returns
the amount of business days between 2 dates, it must start and end in business days. The default
behavior, that is defined in Calendar’s instantiation with adjust.from and adjust.to, reproduces
the Excel’s NETWORKDAYS. A common and useful setting is adjust.to=adjust.next which
moves expiring maturities to the next business day, once it is not.
Examples

```r
bizdays("2013-01-02", "2013-01-31", "Brazil/ANBIMA")

# Once you have a default calendar set, cal does not need to be provided
bizdays.options$set(default.calendar = "Brazil/ANBIMA")
bizdays("2013-01-02", "2013-01-31")

dates <- bizseq("2013-01-01", "2013-01-10")
bizdays(dates, "2014-01-31")
```

Description

`bizdays.options` defines option parameters used internally in `bizdays`.

Usage

`bizdays.options`

Format

A list object with methods `get` and `set` attached to.

Details

Parameters are stored in `bizdays.options` using `get` and `set`

```r
bizdays.options$set(option.key=value)
bizdays.options$get("option.key")
```

`bizdays` supports the following parameter:

- `default.calendar`: the default calendar to be used with the functions: `bizdays`, `bizdayse`, `adjust.next`, `adjust.previous`, `is.bizday`, `bizseq`, `offset`.

Examples

```r
create.calendar(name = "actual")
bizdays.options$set(default.calendar = "actual")
bizdays("2013-07-12", "2013-07-22")
```
**bizdayse**

*Business days and current days equivalence*

**Description**

`bizdayse` stands for business days equivalent, it returns the amount of business days equivalent to a given number of current days.

**Usage**

`bizdayse(dates, curd, cal)`

**Arguments**

- `dates`: the reference dates
- `curd`: the amount of current days
- `cal`: the calendar’s name

**Details**

Let us suppose I have a reference date `dates` and I offset that date by `curd` current days. `bizdayse` returns the business days between the reference date and the new date offset by `curd` current days.

This is equivalent to

```r
refdate <- Sys.Date()
curd <- 10
newdate <- refdate + 10 # offset refdate by 10 days
# this is equals to bizdayse(refdate, 10)
bizdays(refdate, newdate)
```

**Value**

An integer representing an amount of business days.

**Date types accepted**

The argument `dates` accepts Date objects and any object that returns a valid Date object when passed through `as.Date`, which include all POSIX* classes and character objects with ISO formatted dates.

**Recycle rule**

These arguments handle the recycle rule so a vector of dates and a vector of numbers can be provided and once those vectors differs in length the recycle rule is applied.

**Examples**

`bizdayse("2013-01-02", 3, "Brazil/ANBIMA")`
bizdiff

Compute the amount of business days between dates

Description

Returns the number of business days between dates in a given vector of dates.

Usage

bizdiff(dates, cal)

Arguments

dates a vector containing the dates to be differenced

cal the calendar’s name

Value

A ‘numeric’ vector of length ‘n-1’ (where ‘n’ is the input vector length), containing the business days computed between pairs of dates.

Date types accepted

The arguments from and to accept Date objects and any object that returns a valid Date object when passed through as.Date, which include all POSIX* classes and character objects with ISO formatted dates.

Examples

dates <- c("2017-05-10", "2017-05-12", "2017-05-17")
bizdiff(dates, "Brazil/ANBIMA")

bizseq

Create a sequence of business days

Description

Returns a sequence of dates with business days only.

Usage

bizseq(from, to, cal)
Arguments

from  the initial date
to    the final date (must be greater than from)
cal   the calendar's name

Value

A vector of Date objects that are business days according to the provided Calendar.

Date types accepted

The arguments from and to accept Date objects and any object that returns a valid Date object when passed through as.Date, which include all POSIX* classes and character objects with ISO formatted dates.

Examples

bizseq("2013-01-02", "2013-01-31", "Brazil/ANBIMA")

calendar-holidays-weekdays

Description

Returns calendar's list of holidays and weekdays

Usage

holidays(cal)

## Default S3 method:
holidays(cal)

## S3 method for class 'Calendar'
holidays(cal)

## S3 method for class 'character'
holidays(cal)

## Default S3 method:
weekdays(x, ...)

## S3 method for class 'Calendar'
weekdays(x, ...)

## S3 method for class 'character'
weekdays(x, ...)
Arguments

- `cal` character with calendar name or the calendar object
- `x` character with calendar name or the calendar object
- `...` unused argument (this exists to keep compliance with weekdays generic)

Examples

```
holidays("actual")
weekdays("actual")
# empty calls return the default calendar attributes
holidays()
weekdays()
```

Description

The calendars can be specified in JSON files and these functions help with importing and exporting calendars to text files.

Usage

```
save_calendar(cal, con)
load_calendar(con)
```

Arguments

- `cal` the calendar's name
- `con` a connection object or a character string.

Details

`save_calendar` exports a calendar to a JSON file and `load_calendar` imports.

In `load_calendar`, the `con` argument can be a connection object or a character string specifying either the file or the JSON text.

JSON calendar’s specification

Here’s an example of a calendar’s specification.
calendar-register

```{json}
{
  "name": "Brazil/ANBIMA",
  "weekdays": ["saturday", "sunday"],
  "adjust.from": "following",
  "adjust.to": "preceding",
  "financial": true,
}
```

Examples

```r
con <- tempfile(fileext = ".json")
save_calendar("actual", con)
load_calendar(con)
```

calendar-register  

Calendars register

Description

Every calendar created with `create.calendar` is stored in the calendar register. The idea behind this register is allowing calendars to be accessed by its names.

Usage

```r
calendars()
remove_calendars(cals)
has_calendars(cals)
```

Arguments

- **cals** character vector of calendars names

Details

calendars returns the object which represents the calendars register. Since the register inherits from `environment`, the calendars are retrieved with the `[` operator. But the register object has its own print generic which helps listing all registered calendars.

remove_calendars remove calendars from the register.
create.calendar

Examples

# ACTUAL calendar
cal <- create.calendar("Actual")
cal <- calendars()[["Actual"]]
remove_calendars("Actual")
# lists registered calendars
calendars()
has_calendars(c("actual", "weekends"))

create.calendar

Creates calendars

Description

create.calendar creates calendars and stores them in the calendar register.

Usage

create.calendar(
  name,
  holidays = integer(0),
  weekdays = NULL,
  start.date = NULL,
  end.date = NULL,
  adjust.from = adjust.none,
  adjust.to = adjust.none,
  financial = TRUE
)

Arguments

name                     calendar’s name. This is used to retrieve calendars from register.
holidays                 a vector of Dates which contains the holidays
weekdays                 a character vector which defines the weekdays to be used as non-working days
                          (defaults to NULL which represents an actual calendar). It accepts: sunday, monday, tuesday, wednesday, thursday, friday, saturday. Defining the weekend as nonworking days is weekdays=c("saturday", "sunday").
start.date               the date which the calendar starts
end.date                 the date which the calendar ends
adjust.from              is a function to be used with the bizdays’s from argument. That function adjusts the argument if it is a nonworking day according to calendar.
adjust.to                is a function to be used with the bizdays’s to argument. See also adjust.from.
financial                is a logical argument that defaults to TRUE. This argument defines the calendar as a financial or a non financial calendar. Financial calendars don’t consider the ending business day when counting working days in bizdays. bizdays calls for non financial calendars are greater than financial calendars calls by one day.
Details

The arguments start.date and end.date can be set but once they aren't and holidays is set, start.date is defined to min(holidays) and end.date to max(holidays). If holidays isn't set start.date is set to '1970-01-01' and end.date to '2071-01-01'. weekdays is controversial but it is only a sequence of nonworking weekdays. In the great majority of situations it refers to the weekend but it is also possible defining it differently. weekdays accepts a character sequence with lower case weekdays (sunday, monday, tuesday, wednesday, thursday, friday, saturday). This argument defaults to NULL because the default intended behavior for create.calendar returns an actual calendar, so calling create.calendar(name="xxx") returns a actual calendar named xxx. (for more calendars see Day Count Convention) To define the weekend as the nonworking weekdays one could simply use weekdays=c("saturday", "sunday").

The arguments adjust.from and adjust.to are used to adjust bizdays’ arguments from and to, respectively. These arguments need to be adjusted when nonworking days are provided. The default behavior, setting adjust.from=adjust.previous and adjust.to=adjust.next, works like Excel’s function NETWORKDAYS, since that is fairly used by a great number of practitioners.

Calendars register

Every named calendar is stored in a register so that it can be retrieved by its name (in calendars). bizdays’ methods also accept the calendar’s name on their cal argument. Given that, naming calendars is strongly recommended.

See Also

calendars, bizdays

Examples

```r
# ANBIMA’s calendar (from Brazil)
holidays <- as.Date(c(
  "2016-10-12", "2016-11-02", "2016-11-15", "2016-12-25"
))
cal <- create.calendar("ANBIMA",
  holidays = holidays,
  weekdays = c("saturday", "sunday")
)

# ACTUAL calendar
cal <- create.calendar("Actual")

# named calendars can be accessed by its name
create.calendar(name = "Actual")
bizdays("2016-01-01", "2016-03-14", "Actual")
```
getbizdays

Obtaining business days using other dates (or month or year) as reference

Description

Calculates the number of business days for some specific period of a year or a month. getbizdays returns the number of business days according to a reference that can be another date, a month or an year.

Usage

getbizdays(ref, cal = bizdays.options$get("default.calendar"))

Arguments

- **ref**: a reference which represents a month or year, where the date has to be found.
- **cal**: the calendar’s name

getbizdays returns the number of working days according to a reference that can be a month or an year. This reference can be passed as a character vector representing months or years, or as a numeric vector representing years. The ISO format must be used to represent years or months with character vectors.

Examples

# for years
getbizdays(2022:2024, "Brazil/ANBIMA")

# for months
getbizdays("2022-12", "Brazil/ANBIMA")

getdate

Obtaining dates using other dates (or month or year) as reference

Description

Imagine you have one date and want the first or last day of this date’s month. For example, you have the date 2018-02-01 and want the last day of its month. You have to check whether or not its year is a leap year, and this sounds a tough task. getdate helps with returning specific dates according to a reference than can be another date, a month or an year.

Usage

getdate(expr, ref, cal = bizdays.options$get("default.calendar"))
Arguments

expr  a character string specifying the date to be returned (see Details)
ref  a reference which represents a month or year, where the date has to be found.
cal  the calendar's name

expr represents the day has to be returned, here it follows a few examples:
- "second day"
- "10th bizday"
- "3rd wed"
- "last bizday"
- "first fri"

eexpr is a character string with two terms: "<position> <day>

- positions: first or 1st, second or 2nd, third or 3rd, last and XXth (examples 6th or 11th)
- days: day, bizday, or weekdays (sun, mon, tue, wed, thu, fri, sat)

getdate returns dates according to a reference that can be a month or an year. This reference can be passed as a character vector representing months or years, or as a numeric vector representing years. The ISO format must be used to represent years or months with character vectors.

Examples

getdate("10th wed", 2018, "Brazil/ANBIMA")
getdate("last bizday", 2010:2018, "Brazil/ANBIMA")
dts <- seq(as.Date("2018-01-01"), as.Date("2018-12-01"), "month")
getdate("first bizday", format(dts, "%Y-%m"), "Brazil/ANBIMA")
getdate("last bizday", Sys.Date(), "Brazil/ANBIMA")
getdate("next bizday", Sys.Date(), "Brazil/ANBIMA")
getdate("2nd wed", Sys.Date())
getdate("next wed", Sys.Date())
getdate("last wed", Sys.Date())
getdate("next mon", Sys.Date())
getdate("last mon", Sys.Date())

is.bizday  Checks if the given dates are business days.

Description

Returns TRUE if the given date is a business day and FALSE otherwise.

Usage

is.bizday(dates, cal)
load_builtin_calendars

Arguments

dates     dates to be checked
cal       the calendar's name

Value

logical objects informing that given dates are or are not business days.

Date types accepted

The argument dates accepts Date objects and any object that returns a valid Date object when passed through as.Date, which include all POSIX* classes and character objects with ISO formatted dates.

Examples

is.bizday("2013-01-02", "Brazil/ANBIMA")

# Once you have a default calendar set, cal does not need to be provided
bizdays.options$set(default.calendar = "Brazil/ANBIMA")

dates <- seq(as.Date("2013-01-01"), as.Date("2013-01-05"), by = "day")
is.bizday(dates)

load_builtin_calendars

Load builtin calendars

Description

bizdays comes with builtins calendars:

Usage

load_builtin_calendars()

Details

- actual - weekends - Brazil/ANBIMA - Brazil/B3

This function creates and registers these calendars. Once the calendars are loaded they can be used directly by their names.

This function is called in package '.onAttach', so it is not necessary to call it directly. It is for internal use, package development or in situations where the user wants to call bizdays functions without attach the package.

Value

Has no return
Examples

```r
bizdays::load_builtin_calendars()
bizdays::calendars()
bizdays::is.bizday("2020-01-01", "Brazil/ANBIMA")
```

---

### offset

**Offsets the given dates by n business days**

#### Description

Returns the given dates offset by the given amount of n business days.

#### Usage

```r
offset(dates, n, cal)
add.bizdays(dates, n, cal)
```

#### Arguments

- **dates**: dates to be offset
- **n**: the amount of business days to offset
- **cal**: the calendar’s name

#### Details

The argument `n` accepts a sequence of integers and if its length differs from `dates`’ length, the recycle rule is applied to fulfill the gap.

#### Value

Date objects offset by the amount of days defined.

#### Date types accepted

The argument `dates` accepts Date objects and any object that returns a valid Date object when passed through as.Date, which include all POSIX* classes and character objects with ISO formatted dates.

#### Recycle rule

These arguments handle the recycle rule so a vector of dates and a vector of numbers can be provided and once those vectors differs in length the recycle rule is applied.
Examples

```r
offset("2013-01-02", 5, "Brazil/ANBIMA")

# Once you have a default calendar set, cal does not need to be provided
bizdays.options$set(default.calendar = "Brazil/ANBIMA")

dates <- seq(as.Date("2013-01-01"), as.Date("2013-01-05"), by = "day")
is.bizday(dates)
offset(dates, 1)
```

Description

The packages RQuantLib and timeDate (Rmetrics) have functions to compute business days between 2 dates according to a predefined calendar. bizdays creates calendars based on these functions.

Usage

```r
load_quantlib_calendars(ql_calendars = NULL, from, to, financial = TRUE)

load_rmetrics_calendars(year, financial = TRUE)
```

Arguments

- `ql_calendars` (QuantLib only) A character vector with the names of QuantLib’s calendars. This parameter defaults to NULL, which loads all calendars.
- `from` (QuantLib only) the start date
- `to` (QuantLib only) the end date
- `financial` is a logical argument that defaults to TRUE.
- `year` (timeDate Rmetrics only) a vector with years to create the calendars.

Details

To load QuantLib’s calendars use `load_quantlib_calendars` defining which calendar has to be loaded by its name and the range of dates the calendar has to handle. All QuantLib calendars have the QuantLib prefix.

To load Rmetrics’ calendars use `load_rmetrics_calendars` defining the years the calendar has to handle. All Rmetrics calendars have the Rmetrics prefix.

Financial calendars

This argument defines the calendar as a financial or a non financial calendar. Financial calendars don’t consider the ending business day when counting working days in bizdays. In QuantLib, Financial calendars are those that includeLast is set to FALSE.
List of calendars

QuantLib Calendars:

- QuantLib/TARGET
- QuantLib/Argentina
- QuantLib/Australia
- QuantLib/Brazil
- QuantLib/Canada
- QuantLib/Canada/Settlement
- QuantLib/Canada/TSX
- QuantLib/China
- QuantLib/CzechRepublic
- QuantLib/Denmark
- QuantLib/Finland
- QuantLib/Germany
- QuantLib/Germany/FrankfurtStockExchange
- QuantLib/Germany/Settlement
- QuantLib/Germany/Xetra
- QuantLib/Germany/Eurex
- QuantLib/HongKong
- QuantLib/Hungary
- QuantLib/Iceland
- QuantLib/India
- QuantLib/Indonesia
- QuantLib/Italy
- QuantLib/Italy/Settlement
- QuantLib/Italy/Exchange
- QuantLib/Japan
- QuantLib/Mexico
- QuantLib/NewZealand
- QuantLib/Norway
- QuantLib/Poland
- QuantLib/Russia
- QuantLib/SaudiArabia
- QuantLib/Singapore
- QuantLib/Slovakia
- QuantLib/SouthAfrica
- QuantLib/SouthKorea
other-calendars

- QuantLib/SouthKorea/KRX
- QuantLib/Sweden
- QuantLib/Switzerland
- QuantLib/Taiwan
- QuantLib/Turkey
- QuantLib/Ukraine
- QuantLib/UnitedKingdom
- QuantLib/UnitedKingdom/Settlement
- QuantLib/UnitedKingdom/Exchange
- QuantLib/UnitedKingdom/Metals
- QuantLib/UnitedStates
- QuantLib/UnitedStates/Settlement
- QuantLib/UnitedStates/NYSE
- QuantLib/UnitedStates/GovernmentBond
- QuantLib/UnitedStates/NERC

Rmetrics Calendars:

- Calendar Rmetrics/LONDON
- Calendar Rmetrics/NERC
- Calendar Rmetrics/NYSE
- Calendar Rmetrics/TSX
- Calendar Rmetrics/ZURICH

Examples

```r
if (require("RQuantLib")) {
  # loading Argentina calendar
  load_quantlib_calendars("Argentina",
    from = "2016-01-01",
    to = "2016-12-31"
  )
  bizdays("2016-01-01", "2016-03-14", "QuantLib/Argentina")
  # loading 2 calendars
  load_quantlib_calendars(c("UnitedStates/NYSE", "UnitedKingdom/Settlement"),
    from = "2016-01-01", to = "2016-12-31"
  )
  bizdays("2016-01-01", "2016-03-14", "QuantLib/UnitedStates/NYSE")
  # loading all QuantLib's 50 calendars
  load_quantlib_calendars(from = "2016-01-01", to = "2016-12-31")
  bizdays("2016-01-01", "2016-03-14", "QuantLib/Brazil")
}
```

```r
if (require("timeDate")) {
  # loading all Rmetrics calendar
```
load_rmetrics_calendars(2016)
bizdays("2016-01-01", "2016-03-14", "Rmetrics/NERC")
bizdays("2016-01-01", "2016-03-14", "Rmetrics/NYSE")
}
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