Package ‘mondate’

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Type    Package
Title   Keep Track of Dates in Terms of Months
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Author  Dan Murphy
Maintainer  Dan Murphy <chiefmurphy@gmail.com>
Description Keep track of dates in terms of fractional calendar months
                     per Damien Laker "Time Calculations for Annualizing Returns: the Need for Standardization",
                     Model dates as of close of business.
                     Perform date arithmetic in units of "months" and "years".
                     Allow "infinite" dates to model "ultimate" time.
License  MPL-2.0 | file LICENSE
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R topics documented:

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Description

Add numerics to mondates. When units = "months" or "years" and the numeric is a whole number the result has the same day of the month subject to the number of days in the month, thus abandoning mondate's approach of representing days as fractional months. See examples.

Usage

add(e1, e2, units, forcelastday = FALSE)

Arguments

e1 a mondate
e2 a numeric
units Anything allowed by base::as.difftime. In addition, can be "months" or "years". If missing, defaults to timeunits(e1).
forcelastday If FALSE, the result will have the same day of the month subject to the number of days in the month. If TRUE, the day of the month of the result will be the last day of the month if e1 is on the last day of the month.
**Arith-methods**

**Value**

A mondate.

**Author(s)**

Dan Murphy.

**Examples**

```r
x <- mondate(0:12)  # The third date will be the 29th of March
add(x, 1)

x <- mondate.ymd(2013, 1:11, 15)
add(x, 1)  # Always the 15th of the month. Compare to ...
x + 1

stopifnot(add(x, 13, units = "months") == mondate.ymd(2014, 2:12, 15))
```

---

**Description**

Arithmetic methods for class mondate. Includes three special "units between" methods.

**Methods**

- `signature(e1 = "mondate", e2 = "mondate")`: Performs arithmetic operations on two mondates. The result will be numeric with attribute timeunits belonging to the slot of the first argument (with a warning if the two arguments have different timeunits). The only operation that would seem useful for two mondates is subtraction.
- `signature(e1 = "mondate", e2 = "numeric")`
- `signature(e1 = "numeric", e2 = "mondate")`
- `signature(e1 = "mondate", e2 = "array")`
- `signature(e1 = "array", e2 = "mondate")`: Performs arithmetic operations of a numeric on a mondate where the units of the numeric is taken from the timeunits slot of the mondate. The result will be a mondate with the same properties as the mondate in the function call. The only operations that would seem useful for a mondate and a numeric are addition and subtraction.

Most of the time it is expected that timeunits="months" so that, for example, adding/subtracting a number to/from that mondate adds/subtracts that number of months. If the mondate’s timeunits="years" then the perceived intention is to add/subtract that number of years. To accomplish that, the mondate’s numeric value is divided by 12, the operation is performed, and the result converted to a mondate. If the mondate’s timeunits="days", then the mondate’s value is converted to the number of days since the start of the millennium, the operation is performed (e.g., the numeric number of days is added or subtracted), and the result converted to a mondate. (See the convert option of the as.numeric("mondate") function.)
signature(e1 = "mondate", e2 = "difftime")

Use a difftime object to add and subtract secs, days, weeks, months, and years to or from a mondate.

signature(e1 = "mondate", e2 = "mondate") Returns a difftime object equal to the signed number of units between e1 and e2, where "units" = timeunits(e1), with a warning if e1 and e2 have differing timeunits.

MonthsBetween(from = "mondate", to = "mondate") Same as abs(from - to) in months.

YearsBetween(from = "mondate", to = "mondate") Same as abs(from - to) in years, which is also the number of months between divided by 12.

DaysBetween(from = "mondate", to = "mondate") Same as abs(from - to) in days, which is also the difference between the as.Date representation of from and to.

See Also

Arith

Examples

M <- mondate("1-1-2010") # will display in U.S. date format
M - 1:12 # the 1st of the month for all months in 2009
  # in reverse chronological order; inherits M's displayFormat

x <- mondate(matrix(12 * 1:4, 2, 2)) # 2x2 matrix of 2000-2003 year ends
y <- x + 12 # one year later, also a matrix

y - x # 2x2 matrix of 12s, with an attribute ("months")

MonthsBetween(x, y) # same, without the attribute
YearsBetween(x, y)
DaysBetween(x, y)

## Use difftime object to add, subtract secs, days, weeks, months, years
x <- mondate(1) # January 31, 2000
y <- as.difftime(1, units = "days")
x + y
x - y
yw <- as.difftime(1, units = "weeks")
x + yw
x - yw
x + as.difftime(1, , "days")
x + as.difftime(86400, , "secs")

x <- mondate.ymd(2012, 2, 29) # leap day
x + as.difftime(1, , "years") # last day of February 2013, not a leap day
x - as.difftime(1, , "months") # not the last day of January
Array Methods

Description

Apply array attributes to a mondate.

Methods

array(data = NA, dim = length(data), dimnames = NULL) Shapes mondate data as a matrix. Inherits the mondate's other properties. See array for further details.

Examples

M <- mondate.mdy(12, 31, 2006:2011, timeunits = "years") # 6 year-ends
array(M, c(2,3))

as.data.frame method  Coerce a mondate to a Data Frame

Description

Function to coerce a mondate for containment in a data.frame.

Usage

## S3 method for class 'mondate'
as.data.frame(x, row.names = NULL, optional = FALSE, ...)

Arguments

x a mondate.

row.names NULL or a character vector giving the row names for the data frame. Missing values are not allowed.

optional logical. See base::as.data.frame for details.

... optional additional arguments to be passed to or from methods.

Details

Although users would normally call data.frame, the as.data.frame function is the underlying workhorse that enables a mondate to be stored in a data.frame. When array-shaped mondates are stored, the number of rows is retained and if the dimension > 2 it is "flattened" in the usual data.frame sense. The mondate method is fashioned after the as.data.frame.Date method.
See Also

data.frame, as.data.frame.format

Examples

data.frame(yearend = YE, value = 1000 * 1.05^(1:5))  # 5% annual inflation

as.difftime

Description

Expand difftime units to include months and years.

Usage

as.difftime(tim, format = "%X", units = "auto")

Arguments

tim

format

units Anything allowed by base:::as.difftime. In addition, can be "months" or "years" in which case tim must be numeric.

Details

Primarily used to facilitate adding months and years to mondates. See base:::as.difftime.

Value

See base:::as.difftime.

Author(s)

Dan Murphy.

See Also

Base as.difftime

Examples

x <- mondate(0:12)
y <- as.difftime(1, , "months")
x + y
x - y
as.list method

Construct a list from a mondate

Description

Function to construct a list from a mondate.

Usage

## S3 method for class "quotesingle.Var"
mondate/quotesingle.Var

as.list(x, ...)

Arguments

x
a mondate.

... optional additional arguments to be passed to or from methods.

Details

Constructs a list from a mondate object. The length of the list equals the length of x. Each sublist contains an individual element of x. This method is most useful when a mondate is the x argument of one of the *apply functions. See an example of a recommended call to sapply in "Examples" below.

Examples

YE <- mondate.mdy(12, 31, 2011:2012)
sapply(YE, class) # "mondate" "mondate"
sapply(YE, month) # same as month(YE)
month(YE)

as.mondeate

As.Mondeate Method

Description

Coerce an object to class mondate.

Usage

as.mondeate(x, ...)

Arguments

x an R object.

... optional arguments passed to other methods.
Coersion-from-mondate methods

Details

This is a convenience function that simply calls the appropriate mondate conversion method depending on the class of x.

Value

A mondate if coersion is successful.

Author(s)

Dan Murphy

See Also

mondate-methods

Examples

```r
y <- as.Date("2012-12-31")
as.mondate(y)
```

---

Coersion-from-mondate methods

Coersion Methods for Mondates

Description

Methods to coerce a mondate to other R objects. Currently that includes numbers, characters, and three classes of dates.

Usage

```r
## S3 method for class 'mondate'
as.character(x, format, ...)
## S3 method for class 'mondate'
as.Date(x, ...)
## S3 method for class 'mondate'
as.POSIXct(x, ...)
## S3 method for class 'mondate'
as.POSIXlt(x, ...)
## S4 method for signature 'mondate'
as.numeric(x, convert = FALSE, stripdim = FALSE,
         timeunits = c("months", "years", "days"),
         ...)
```
Arguments

- **x**: a mondate
- **format**: the format to give the Date representation of x
- **convert**: See Methods
- **stripdim**: See Methods
- **timeunits**: See Methods

Methods

- `as.character(x = "mondate", format, ...)`: Coerce mondate to class character. Uses the `format` function.
  - **format**: If missing the value is drawn from the `displayFormat` property of x.
  - **...**: arguments passed to other methods (e.g., `format`).
- `as.numeric(x = "mondate", convert=FALSE, stripdim=FALSE, timeunits=c("months","years","days"),...)`: Coerce mondate to class numeric.
  - **convert**: FALSE (the default) is equivalent to `getDataPart`. If TRUE the result will be converted to the number of years since the beginning of the millennium if `timeunits="years"`; to the number of days since the beginning of the millennium if `timeunits="days"`. Also in the case that `convert=TRUE` the numeric returned will have "timeunits" as an attribute.
  - **stripdim**: FALSE (the default) retains the array attributes `dim` and `dimnames`. If TRUE the dimension attributes are stripped, which is the default behavior of `base::as.numeric`.
  - **timeunits**: If missing the value is drawn from the property of the mondate.
- `as.Date(x = "mondate")`: Coerce mondate to class `Date`
- `as.POSIXlt(x = "mondate")`: Coerce mondate to class `POSIXlt`
- `as.POSIXct(x = "mondate")`: Coerce mondate to class `POSIXct`

Examples

```r
(b<-mondate(1)) # end of first month of current millennium
as.numeric(b) # 1
as.character(b) # December 31, 2000 in date format of locale
as.character(b, format="%b-%Y") # "Dec-2000"
as.numeric(b, convert=TRUE, timeunits="years") # converts to 1/12 "years"
(b<-mondate(1, timeunits="days")) # end of first day of millennium
as.numeric(b) # 1/31
as.numeric(b, convert=TRUE) # 1 (with a "days" attribute)
as.Date(b) # displays as "2000-01-31"
as.POSIXct(b) # displays as "2000-01-31 UTC"
weekdays(as.POSIXct(b)) # January 31, 2000 was a "Saturday" (in English)
as.POSIXlt(b)$hour # zero, as are ...$min and ...$sec
```
Combining-methods

Methods for Combining Mondates

Description

Methods to combine mondates.

Usage

```r
cbindmondate(..., deparse.level = 1)
rbindmondate(..., deparse.level = 1)
## S3 method for class 'mondate'
rep(x, ...)
## S4 method for signature 'mondate'
c(x, ..., recursive = FALSE)
```

Arguments

- **x**
  - a mondate
- **deparse.level**
  - see `base::cbind`
- **recursive**
  - see `base::c`
- **...**
  - arguments passed to and from other methods

Details

The package calls `setGeneric("c-rbind")`.

Value

```r
c-rbindmondate(...)  
```

The `cbindmondate` and `rbindmondate` functions are similar to the base `cbind` and `rbind` functions, respectively, to combine the arguments. If all arguments are mondates then the result is converted to a mondate with `displayFormat` and `timeunits` properties equal to those of the first argument in `...`. If not all arguments are mondates then the result is a `data.frame` by virtue of the call `cbind.data.frame(...)`. A mondate (or a `data.frame` from `c-rbindmondate` when `...` holds non-mondate arguments). For `c` and `rep`, a vector.

Methods

- **c(x = "mondate", ...)** Combine mondates into a vector. ..., any R object(s) that can be coerced to a mondate. The behavior mimics that of the base function. The result will be a mondate with properties equal to those of `x`.

- **rep(x = "mondate", ...)** Replicates a mondate. The behavior mimics that of the base function. See `rep` for further details. The result will be a mondate with properties equal to those of `x`. 
Examples

\begin{verbatim}
  x <- mondate(1:6)  # first 6 month-ends of the year 2000
  c(x,x+6)           # all month-ends of 2000
  c(0,x)            # result is "numeric", as determined by the first argument

  M<-mondate.ymd(2001:2005,12,31)  # 5 year-ends
  names(M)<-LETTERS[1:5]
  cbindmondate(M)                             # as a 5x1 matrix
  rbindmondate(M,M)

  begin_date <- M-12
  cbindmondate(begin_date,end_date=M)        # 5 pairs of year boundary-dates. Columns
                                             # are "automatically" named in the default case
                                             # (all mondates with timeunits="months").

  dayt <- as.Date("2010-6-30")
  cbindmondate(x,mondate(dayt))              # column names show as 'x' and blank
  cbindmondate(x=x,DateColumn=mondate("2010-6-30"))  # both columns are named

  rep(mondate("2010-2-14"), 3)

  (M<-seq(from=mondate("1/1/2010"),length=2))  # Jan. and Feb. 1st
  rep(M,3)  # three pairs
  rep(M,each=3)  # three Jan.'s, three Feb.'s
\end{verbatim}

Compare-methods

\subsection*{Description}
Methods for the Compare group of functions.

\subsection*{Methods}
\verbatim
signature(e1 = "mondate", e2 = "mondate")
\end{verbatim}

compare two mondates. The usual recycling rules apply to the shorter of the two mondates. The result will be logical. The usual rules apply as to the shape of the result.

\subsection*{See Also}
\verbatim
Compare
\end{verbatim}

\subsection*{Examples}
\verbatim
A<-mondate.ymd(2001:2003,12,31)  # three year ends
B<-mondate.ymd(2001:2003, 6,30)  # three mid-years
B<A                              # c(TRUE, TRUE, TRUE)
\end{verbatim}
**cut.mondeate**

Convert a mondate Object to a Factor

### Description
Method for cut applied to mondate objects.

### Usage
```r
## S3 method for class 'mondate'
cut(x, breaks, labels = NULL,
    include.lowest = TRUE, right = TRUE,
    start.on.monday = TRUE, attr.breaks = FALSE, ...)
```

### Arguments
- **x**: a mondate
- **breaks**: a vector of cut points or number giving the number of intervals which x is to be
  cut into or an interval specification, one of "day", "week", "month", "quarter"
  or "year", optionally preceded by an integer and a space, or followed by "s"
  (pluralized).
- **labels**: labels for the levels of the resulting category. By default, labels are constructed
  from the right-hand end of the intervals (which are included for the default value
  of right). If `labels = FALSE`, simple integer codes are returned instead of a
  factor.
- **include.lowest**: logical, indicating if an 'x[i]' equal to the lowest (or highest, for
  `right = FALSE`) 'breaks' value should be included.
- **right**: logical, indicating if the intervals should be closed on the right (and open on the
  left) or vice versa.
- **start.on.monday**: logical. If `breaks = "weeks"`, should the week start on Mondays or Sundays?
- **attr.breaks**: logical. If TRUE the result has a "breaks" attribute which is a mondate whose
  pairwise values determine a covering of x. Most helpful when `breaks = "days",
  "weeks", "months", "quarters", or "years".
- **...**: optional arguments passed to or from other methods.

### Details
Convert a mondate to a factor where, in the "end-of-business-day" spirit of mondate, the levels are
labeled by the last day in the period. If `right = FALSE` the levels are labeled by the first day in the
period.

For numeric breaks – which case also includes mondates – the method calls `cut.default` and the
intervals encoded in the levels are converted to date format using mondate logic. In the spirit of
mondate, the default `right = TRUE` ensures that the intervals are left-open/right-closed. The default
`include.lowest = TRUE` ensures that `min(x)` is included in the first interval.
For breaks = "days" or "weeks", the method calls cut(as.Date(x)). For breaks = "months", "quarters", and "years", numeric breaks are determined from the range of x.

If breaks is preceded by an integer, call it step, then the period of the first level is determined by min(x) and subsequent "day", "week", "month", "quarter", and "year" periods are determined sequentially per seq(min(x), max(x), by = step).

When attr.breaks = TRUE, the result will have a "breaks" attribute (attr(., "breaks")) which pairwise "cover" x. Such "breaks" are suitable be use by 'hist', for example.

In all cases, the formats of the dates representing the levels are inherited from displayFormat(x). Accordingly, if such resulting potential levels would be non-unique, cut.mondeate resorts to the fall-back scheme of cut.default, i.e., "labels such as "Range3" will be used."

**Value**

A factor is returned, unless labels = FALSE which returns the integer level codes.

**Author(s)**

Dan Murphy. Many thanks to the R-development team for cut and cut.Date.

**See Also**

cut and cut.Date

**Examples**

```r
x <- mondate(0:12)
cut(x, breaks = 4)
cut(x, mondate.ymd(1999) + c(0, 3, 6, 9, 12)) # same as above

# days
x <- mondate.ymd(2013, 1, 1:7)
cut(x, breaks = "days")

# weeks
x <- mondate.ymd(2013, 1, 1:31) # days in January 2013
cut(x, breaks = "weeks") # labeled by the first 5 Sundays of 2013
cut(x, breaks = "2 weeks") # labeled by 2nd, 4th, and 6th Sundays of 2013

# months
x <- mondate.ymd(2013, 1:12, 15) # 15th day of each month in 2013
cut(x, breaks = "months") # labeled by last day of the month
cut(x, breaks = "months", right = FALSE) # labeled by first day of the month
cut(x, breaks = "2 months") # labeled by last day of the month
x1 <- mondate.ymd(2008, 6)
x2 <- mondate.ymd(2008:2011, 6)
cx1 <- cut(x1, "month", right = FALSE)
cx2 <- cut(x2, "month", right = FALSE)
stopifnot(levels(cx1)[cx1] == levels(cx2)[cx2[1]])

# quarters
x <- mondate.ymd(2013, 1:12, 15) # 15th day of each month in 2013
```
cut(x, "quarters") # labeled by last day of the quarter
cut(x, "quarters", right = FALSE) # labeled by first day of the quarter
cut(x, "2 quarters")
cut(x, "2 quarters", right = FALSE) # labeled by first day of the quarter

# years
m <- mondate(0:12)
cut(m, "years") # labeled by last day of the year
cut(m, "years", right = FALSE) # labeled by last day of the year
displayFormat(m) <- "%Y"
cut(m, "years") # labeled by just the year
x <- mondate.ymd(2008:2013, 6)
cut(x, "years") # 6 levels labeled by last day of the year
cut(x, "years", right = FALSE) # 6 levels labeled by first day of the year
cut(x, "3 years") # 2 levels
cut(x, "3 years", right = FALSE) # 2 levels

x1 <- mondate.ymd(2008, 12)
x2 <- mondate.ymd(2008:2011, 12)
cx1 <- cut(x1, "year", right = FALSE)
cx2 <- cut(x2, "year", right = FALSE)
stopifnot(levels(cx1)[cx1] == levels(cx2)[cx2[1]])

diff.monde - 'diff' for package mondate

Description

Returns suitably lagged and iterated differences of an object of class mondate.

Usage

## S3 method for class 'mondate'
diff(x, lag = 1L, differences = 1L, ...)

Arguments

x a mondate vector or matrix containing the values to be differenced.
lag an integer indicating which lag to use.
differences an integer indicating the order of the difference.
... further arguments to be passed to or from methods.

Details

See the diff function in base.
Value

If \( x \) is a vector of length \( n \) and \( \text{differences}=1 \), then the computed result is equal to the successive differences \( x[(1+\text{lag}):n] - x[1:(n-\text{lag})] \).

If \( \text{difference} \) is larger than one this algorithm is applied recursively to \( x \). Note that the returned value is a vector which is shorter than \( x \).

If \( x \) is a matrix then the difference operations are carried out on each column separately.

Author(s)

Dan Murphy

See Also

diff

Examples

evalDate<-'mondate(c(12+12*1:10)) # year ends 2001, ..., 2010
diff(evalDate) # vector of length 9 holding the number 12,
# with "timeunits" attribute = "months"

difftime-class  
Class "difftime"

Description

Register old-style (a.k.a. 'S3') class as a formally defined class.

Author(s)

Dan Murphy

displayFormat-methods  
Methods to Access 'displayFormat' Property

Usage

### S4 method for signature 'mondate'
displayFormat(x)
### S4 method for signature 'ANY'
displayFormat(x)
### S4 replacement method for signature 'mondate'
displayFormat(x)<-value
Arguments

x  a mondate.
value  For the "get" method, a character string indicating the date format with which to display the mondate. Choices are currently
1. "%m/%d/%Y"
2. "%m-%d-%Y"
3. "%Y-%m-%d"
4. "%Y/%m/%d"

If x is not a mondate, the "get" value returned is NULL.

Note

The mondateDisplayFormat versions have been deprecated.

Examples

x<-mondate("2010-6-30") # The middle of 2010
displayFormat(x) # "%Y-%m-%d"
displayFormat(x) <- "%m/%d/%Y"
x # x now displays as 06/30/2010

format.mondate  Format a mondate

Description

Function to format a mondate into its character representation according to the displayFormat property.

Usage

## S3 method for class 'mondate'
format(x, ...)

Arguments

x  a mondate.
...  further arguments passed to or from other methods.

Details

For more details see format and especially strptime.

Value

character representation of the mondate.
See Also

strptime.

Examples

(b <- mondate(1))  # end of first month of millennium
format(b)           # "01/31/2000" -- with quotes -- in the U.S. locale
format(b, format = "%Y-%m-%d")  # "2000-12-31"

funcNULL-class      Class "funcNULL"

Description

A class representing a function for special mondate formatting if necessary or NULL if not.

Author(s)

Dan Murphy

matrix-methods     Matrix Methods for Mondate's

Description

Apply matrix attributes to a mondate.

Methods

matrix(data = NA, nrow = 1, ncol = 1, byrow = FALSE, dimnames = NULL)  Shapes mondate data as a matrix. Inherits the mondate's other properties. See matrix for further details.

Examples

m <- mondate.mdy(12, 31, 2001:2006)  # 6 year-ends
matrix(m)                           # a one-column matrix
matrix(m, 2, byrow = TRUE)          # a two-row matrix stored in row-order
Miscellaneous Methods for mondate's

Description

Miscellaneous mondate methods.

Usage

### S3 method for class 'mondate'

```r
mean(x, trim = 0, na.rm = FALSE, ...)
```

### S3 method for class 'mondate'

```r
unique(x, ...)
```

### S3 method for class 'mondate'

```r
quarters(x, abbreviate)
```

Arguments

- **x** a mondate
- **trim** see base::mean
- **na.rm** see base::mean
- **abbreviate** logical. Should the names be abbreviated?
- **...** arguments passed to and from other methods

Methods

- **mean(x = "mondate", ...)** Calculate the mean date of mondates. Arguments **trim** and **na.rm** have the usual meaning (see base::mean).
- **pmean(... = "mondate")** Calculate the "parallel" mean date of mondates. Arguments in ... must all be mondates. Result will be a mondate with properties equal to those of the first mondate in ....
- **unique(x = "mondate", ...)** Returns a mondate but with duplicate elements/rows removed. For an explanation of the arguments in ..., see base::unique.
- **quarters(x = "mondate", abbreviate)** Returns a character vector of "Q1" to "Q4". See quarters.

Examples

```r
(M <- mondate.mdy(12,31,2001:2003))
mean(M) # the middle value, Dec. 31, 2002
(M <- c(M, mondate.mdy(12,31,2004))) # tack on another yearend
mean(M) # mid-year 2003
mean(M, 12) # 12 is coerced to Dec. 31, 2000, so the # mean is again Dec. 31, 2002

x <- mondate.ymd(2001:2005,12) # five year ends
y <- x-12 # one year earlier
```
Description

A mondate represents a date as a numeric equalling the number of months since the beginning of the current millennium (the "mondate epoch"). Somewhat arbitrarily, and at the risk of reopening a decade-old debate, "the beginning of the current millennium" is defined as the instant between December 31, 1999 and January 1, 2000.

The need for a "mondate" class arises in the area of actuarial analysis, and other areas of financial modeling that need to reconcile to a company’s book of accounts. Its motivation is based on the following presumptions:

1. Business accounting-wise, the closing of the books for a month, quarter, and year are the important milestones for measuring time.
2. For accountants – and actuaries – it is usually not important to measure events on an hourly basis.
3. All events that occur during a business day, up to and including the closing of the books for a day, are all "accounted for" as having occurred "at the same time."

To appreciate the difficulty in measuring the passage of time in days, note that there are typically three fewer days in the first half of the year (January 1 through June 30) than there are in the second half. Yet accountants will say that on June 30th the year is half over. For another example, note that – with the exception of July/August and December/January – the same days of the month for two consecutive months are not one "month" apart if measured in days because, with those exceptions, consecutive months contain differing numbers of days, so which of the two months do you choose as the yardstick? Since changes in accounts over the course of a month, quarter and year are the amounts by which financial results are measured, it is important to be able to measure the passage of time where a year is comprised of twelve months of equal "accounting weight."

That gives rise to a date as measured in months, coined "mondate".

A mondate is simply a real number whose fractional part represents the fraction of the month as of the end of the day. E.g., the fractional part of January 1st = 1/31; the fractional part of February 1st = 1/28 or 1/29, depending on the year. A mondate which is a whole number (i.e., no fractional part) corresponds to a month that is fully completed, whose subsequent month has not yet begun; i.e., the instant in time between one month and the next.

The length of time (in months) between mondate x and mondate y is simply y−x. An interval of time is represented in a mathematical sense by the half-open/half-closed interval (x,y]. For example, calendar year 2009 is the interval
i.e., all events after the close of business 2008-12-31 and through and including the close of business 2009-12-31. The mondate vector
\[
c(\text{mondate}("2008-12-31"), \text{mondate}("2009-12-31"))
\]
could be used to represent such an interval.

A mondate allows "infinite dates", which are helpful constructs for modeling "ultimate" events in actuarial, longitudinal, and time series analyses (see the mondate method for signature "numeric"). A mondate has two important properties (in S4 parlance, "slots"). The first is displayFormat which is the format of the date when the mondate is printed or shown. The other is timeunits which is the "units" reported when date arithmetic is performed. The default units is "months", but "years" and "days" are also allowed, in which case the difference of two dates, say, would be reported in "years" or "days", respectively.

**Objects from the Class**

Objects can be created by calls of the form mondate(x,...).

**Slots**

.Data: Object of class "numeric" or a numeric array
displayFormat: Object of class "character". The is the format of the date when displayed. Currently, there are four choices:
1. "
2. "
3. "
4. "
Currently, the default displayFormat for a "United States" locale is mm/dd/YYYY (" in all other locales YYYYY-mm-dd" (The default can be changed to another format using options(mondate.displayFormat = myFormat)). See Examples.
timeunits: Object of class "character" There are three options:
"months": the default
"years": although it is assumed that "month" is the fundamental unit of time, sometimes it is more convenient to report the result of date arithmetic in terms of "years", for example, in actuarial analyses when events are measured over the course of years, not months. Of course, one "year" = twelve "months".
"days": mostly for convenience when the number of days between events needs to be reported. Of course, unlike with "years", there is no simple relationship between "days" and "months" – it depends on the month and year of the date. If the fundamental unit of time for a particular problem is "days", not "months", then a different date class (e.g., class Date) might be a better tool for modeling the passage of time for that problem.

The default can be changed to a different unit using the options(mondate.timeunits = myUnits) command. See Examples.
mondate-methods

formatFUN: Object of class "funcNULL" Use this slot to store a function to format a mondate. See Examples.

Extends
Class c("numeric","array"), from data part.

Author(s)
Dan Murphy

References

See Also
yearmon in the zoo package.

Examples

# See the \code{mondate-methods} section for an explanation of the \code{mondate} method below.
# January 1, 2010 in US displayFormat
mondate("1-1-2010")

# generate 10 random dates in calendar year 2000; will be displayed in local format
mondate(runif(10,0,12))

# Change the default format so that the character representation of the date sorts in chronological order.
options(mondate.displayFormat = "%Y-%m-%d")
# January
mondate(runif(10,0,12))

# generate 10 random dates in calendar year 2010;
# date arithmetic results will be reported in units of "years"
mondate(10+runif(10),timeunits="years")
Usage

```r
mondate(x,
    displayFormat = getOption("mondate.displayFormat",
        default = .get.default.displayFormat()),
    timeunits = getOption("mondate.timeunits",
        default = .get.default.timeunits()),
    ...)
```

## S4 method for signature 'mondate'

```r
mondate(x, displayFormat, timeunits, formatFUN, ...)
```

## S4 method for signature 'numeric'

```r
mondate(x, displayFormat, timeunits, ...)
```

## S4 method for signature 'Date'

```r
mondate(x, displayFormat, timeunits, ...)
```

## S4 method for signature 'POSIXt'

```r
mondate(x, displayFormat, timeunits, ...)
```

## S4 method for signature 'character'

```r
mondate(x, displayFormat = "keep", timeunits, format, ...)
```

## S4 method for signature 'array'

```r
mondate(x, displayFormat, timeunits, ...)
```

## S4 method for signature 'missing'

```r
mondate(x, displayFormat, timeunits, ...)
```

## S4 method for signature 'ANY'

```r
mondate(x, displayFormat, timeunits, ...)
```

Arguments

- **x**: an R object to convert to a mondate. Can be another mondate, a character representing a date, a date, a numeric, or an object which converts to a numeric with `as.numeric(x)`. More details below.

- **displayFormat**: character string representing the date format with which to display the mondate. The default, `displayFormat` is determined at the time an instance is created according to `Sys.getenv("LC_TIME")`: if it contains the words "United States", the default will be ",%m/%d/%Y" (MM/DD/YYYY), otherwise ",%Y-%m-%d" (YYYY-MM-DD). Other choices are ",%m-%d-%Y" and ",%Y/%m/%d". See "Details" section for how to change defaults.

- **timeunits**: character string "months" (default), "years", or "days" indicating the units in which date arithmetic will be carried out.

- **formatFUN**: format function for converting a mondate to character. In case of conversion from mondate, default is to inherit the value.

- **format**: format string for converting a character to a Date (using `as.Date(x, format,...)` from which the mondate value is determined.

- **...**: arguments to be passed to other methods.
Details

Package users can change the default values of displayFormat and timeunits using options() with the names "mondate.displayFormat" and "mondate.timeunits", respectively. Warning! Use with care! No checks are performed if and when the options are established. It is up to the user to ensure the new defaults are valid – displayFormat must be appropriate for formatting dates in R and timeunits must be one of "months", "years", or "days". See an example below.

Methods

signature(x = "mondate") For mondate x, this could be a way to copy a mondate and perhaps change the mondate's displayFormat or timeunits slots in the process. For any class that extends mondate, use of this method will return the underlying mondate class without additional slots (if any) of the subclass.

signature(x = "numeric") For numeric x, the simplest case is when timeunits = "months", in which case the value of x and properties displayFormat and timeunits are simply stored. If timeunits = "years" then it is presumed that the value of x represents the number of years since the beginning of the millennium, in which case the value of x is multiplied by 12 and then stored. If timeunits = "days" then it is presumed that the value of x represents the number of days since the beginning of the millennium, in which case the value is calculated using as.Date. Note that infinite values of x are allowed, helpful in actuarial ("at ultimate") longitudinal, and time series modeling.

signature(x = "Date") signature(x = "POSIXt") For a date x, as.POSIXlt is used to convert to an ISO standard date, from which the number of months of that day since the beginning of the millennium is calculated.

signature(x = "character") If format is provided, then that format is used to attempt to convert the character value to a date. Otherwise, characters are converted to dates using the first format found in the set of valid formats that successfully converts the first non-NA entry in x, and that format is retained as the displayFormat of the result unless the user explicitly provides a value for displayFormat. The current set of valid formats is "%m/%d/%Y", "%m-%d-%Y", "%Y-%m-%d", and "%Y/%m/%d". If any entries of x do not convert successfully, those entries get the value NA and a warning is issued. Finally, if format is not provided and none of the valid formats successfully converts x to a date, then as a last resort the character string is attempted to be coerced to a numeric and then to a mondate.

signature(x = "factor") The character method is run on as.character(x).

signature(x = "array") If an object x is an array, then this method enables the mondate to inherit its shape. After that, other "signatures" take over.

signature(x = "missing") Enables the call mondate() to work. Useful for prototypes, e.g. Body of method is simply new("mondate").

signature(x = "ANY") For any other class of x an attempt will be made to convert to Date("as.Date(x)"). If unsuccessful, an attempt will be made to convert to numeric; if successful, a warning will be issued to check the results relative to the numeric conversion, otherwise execution will be stopped.

See Also

POSIXt, yearmon, yearqtr
Examples

```r
mondate("1-31-2010") # Jan. 31, 2010
mondate(60) # 60 months after 12/31/1999, so Dec. 31, 2004
dat <- as.Date("2010-1-31")
(M <- mondate(dat)) # Jan. 31, 2010
x <- 12 * 1:6
mondate(x) # first 6 yearends in 2000's
y <- x + 12
mondate(cbind(x,y)) # bounding dates of first 6 years of millennium
(y <- mondate((1:6, timeunits="years"))) # first 6 yearends, 'years' timeunits
# The results of date arithmetic on y will be displayed in "years".
# E.g., the differences of y can be calculated as:
tail(y,-1) - head(y,-1)# vector of five 1's, with "timeunits" attribute = "years"
as.numeric(x)
as.numeric(y) # the underlying numeric representations are the same

# Demonstrating "infinite" dates
y <- c(y, Inf)
y # last element shows as Inf
tail(y,-1) - head(y,-1)# last element is now infinity

# The zoo examples point out a difference between zoo and mondate.
# zoo assumes that the zero-th part of a month or quarter is the first
# day of the month or quarter, whereas mondate assumes that it is
# the instant before the first day of the month or quarter.
# Since frac=0 is zoo's as.Date coercion default, a month or quarter in
# zoo's sense converts to the end of the first day rather than
# the beginning.
library(zoo)
x <- ts(1:10, frequency = 4, start = c(1959, 2)) # starting 2nd qtr of 1959
x
# There is no method for class 'ts' so x is coerced (successfully)
# because that class has an as.Date method, but with a warning.
# The result is a vector of length 10 representing the close of business
# at the end of the first day of each of the given quarters.
mondate(x)

# The yearmon class will identify any day in June 2010 with that month.
as.yearmon("2010-6-15")
mondate(as.yearmon("2010-6-15")) # end of first day of June 2010
mondate(as.yearmon("2010-6-15", frac=1)) # end of last day of June 2010
mondate(as.yearqtr("2010-2", frac=1)) # same

# The if missing, displayFormat will be determined from the character input
x <- mondate("2010-12-31")
x # x displays in the input European format
# The provided, displayFormat must match the format of the character input
# or NA's will result.
mondate("2010-12-31", displayFormat = "%m-%d-%Y") # results in NA

# Always display x using just the year
x <- mondate(as.Date("2012-3-1"), displayFormat="%Y")
```
x            # shows as the year 2012, but month and day are nevertheless retained
month(x)    # 3
day(x)       # 1

# Change the default displayFormat to only display the year and month
options(monde.date.displayFormat = "%Y-%m")
y <- mondate(as.Date("2013-12-31"))
y
# mondate: timeunits="months"
# [1] 2013-12
# Previous mondate instances retain their display formats:
x
# mondate: timeunits="months"
# [1] 2012

names method

Assign names to a mondate.

Description
Function to assign names to a mondate.

Usage
## S3 replacement method for class 'mondate'
names(x) <- value

Arguments
x          a mondate.
value      the names to assign to x

Details
Assigns the names attribute to the .Data part of x.

Examples
YE <- mondate.mdy(12, 31, 2011:2012)
names(YE) <- c("A", "B")
print-methods

Methods to Display a Mondate

Description
Methods to display a mondate in an R session.

Usage

## S3 method for class 'mondate'
print(x, ...)
## S4 method for signature 'mondate'
show(object)

Arguments

x  a mondate
object  a mondate
...  arguments passed to and from other methods

Methods

print(x = "mondate", ...) Print the date in its character representation using the
displayFormat property. Uses the noquote function. Arguments in ... are passed to base::print.
show(object = "mondate") Same as print above, but with a "header" showing the timeunits property.

seq.mondate

Mondate Sequence Generation

Description
Generate regular mondate sequences.

Usage

## S3 method for class 'mondate'
seq(from, to, ...)

Arguments

from  a mondate. May be "missing".
to  a mondate. May be "missing".
...  optional arguments passed to seq.default, including by, length.out, and along.with. See seq for more details.
**Details**

For more details about sequence generation, see `seq`.

If `from` and `to` are both provided, the `displayFormat` and `timeunits` properties are taken from `from`, without a warning if `from`'s properties differ from `to`'s.

**Value**

A mondate vector with `displayFormat` and `timeunits` from argument `from`, if provided, otherwise from argument `to`.

**Author(s)**

Dan Murphy

**See Also**

`seq`

**Examples**

```r
x<-mondate(ymd(2010,1))
x # January 31, 2010
y<-mondate(ymd(2010,12))
y # December 31, 2010
seq(from=x, to=y) # all month-ends in 2010
# 8 quarter-ends beginning 1st quarter 2009; US displayFormat
seq(mondeate("3/31/2009"), by=3, length.out=8)
# 8 quarter-ends ending year-end 2009; non-US displayFormat
seq(to=mondate("2009/12/31"), by=3, length.out=8)
```

---

**subtract**

`Subtract numerics from mondates using day-of-month logic`

**Description**

Subtract numerics from mondates. When units = "months" and the numeric is a whole number the result has the same day of the month subject to the number of days in the month, thus abandoning mondate's approach of representing days as fractional months. See examples.

**Usage**

`subtract(e1, e2, units, forcelastday = FALSE)`
Arguments

\begin{itemize}
\item \texttt{e1} \texttt{a} \texttt{mondate}
\item \texttt{e2} \texttt{anumeric}
\item \texttt{units} Anything allowed by \texttt{base::as.difftime}. In addition, can be "months" or "years". If missing, defaults to \texttt{timeunits(e1)}.
\item \texttt{forcelslastday} If FALSE, the result will have the same day of the month subject to the number of days in the month. If TRUE, the day of the month of the result will be the last day of the month if \texttt{e1} is on the last day of the month.
\end{itemize}

Value

A mondate.

Author(s)

Dan Murphy.

Examples

\begin{verbatim}
x <- mondate(0:12)
subtract(x, 1) # The third date will the the 29th of March
x <- mondate.ymd(2013, 2:12, 15)
subtract(x, 1) # Always the 15th of the month. Compare to ...
x - 1
stopifnot(subtract(x, 1, units = "months") == mondate.ymd(2013, 1:11, 15))
\end{verbatim}

Description

Methods for the \texttt{Summary} group of functions.

Methods

\texttt{signature(x = "mondate")} summarizes a mondate.

The result will be a mondate with the same \texttt{displayFormat} and \texttt{timeunits} properties.

The usual rules apply as to the shape of the result.

Examples

\begin{verbatim}
A <- mondate.ymd(2001:2010, 12, 31) # ten yearends
min(A) # December 31, 2001
max(A) # December 31, 2010
range(A)
\end{verbatim}
Methods to Access 'timeunits' Property

Description

Methods to get and set the timeunits value of a mondate.

Usage

```r
## S4 method for signature 'mondate'
## S4 method for signature 'ANY'
## S4 replacement method for signature 'mondate'
```

### Arguments

- **x**: a mondate.
- **value**: For the "get" method, a character string indicating the units with which to measure time as a result of operations on a mondate. Choices are currently
  1. "months"
  2. "years"
  3. "days"

If `x` is not a mondate, the "get" value returned is NULL.

Note

The mondateTimeunits versions have been deprecated.

Examples

```r
x <- mondate("2010-6-30") # The middle of 2010
timeunits(x) # "months"
y <- x + 12 # One year (12 months) later.
timeunits(y) # "months"
y - x # Result is 12 months
timeunits(y) <- "years" # Result is 1 year, with a warning because
# x@timeunits != y@timeunits. Units of result
# comes from the first argument.
y - x
timeunits(y) <- "days" # Result is 365 days -- warning suppressed
suppressWarnings(y - x)
```
Useful Methods for Class mondate

Description

The methods in this section facilitate year-, month-, day-, and quarter-number extraction from objects that represent dates, as well as mondate construction using the year, month, and day numbers of the date (as those numbers would be seen in the character representation of the date, i.e., "January" = 1 and the first day of a month = 1).

Usage

```
year(x, ...)  
month(x, ...)  
day(x, ...)  
quarter(x, ...)  
ymd(x)  

mondate.mdy(m, d, y, ...)  
mondate.ymd(y, m, d, ...)  
```

Arguments

```
x an object of class mondate, Date, or POSIXt  
m the month: 1, ..., 12. If "missing" and d is also "missing", m=12 by default.  
d the day: 1, ..., 31, depending on the month. If "missing" in the case of mondate.ymd, the last day of the month is inserted.  
y the four-digit year.  
... For year, month, and day, not used. For mondate.mdy and mondate.ymd arguments to be passed to the mondate constructor, e.g., displayFormat and timeunits.  
```

Value

```
year returns the year numeric (e.g., 2000).  
month returns the month numeric 1, ..., 12.  
day returns the numeric day of the month.  
quarter returns the numeric calendar quarter of the year: 1 for January - March, 2 for April - June, etc.  
ymd returns a matrix with the number of rows equal to the length of x, with appropriately-named columns 1 through 3 holding the year, month, and day, respectively and with "rownames" equal to names(x).  
```
mondate.mdy and mondate.ymd return mondates with the given month, day, and year. Arguments 
m, d, and y may have length > 1; the usual recycling rules apply.

The mondate.mdy function has a bit more functionality. If d is "missing" in a call to mondate.ymd 
then the date returned will be the last day of month m in year y. If m is also missing, then the date 
returned will be the last day of the year. If any of y, m, or d are NA the result will be an all-NA vector.
And if y=+Inf then the result will be an "infinite" mondate vector, overriding other rules included 
herein. The length of a vector result is determined using the usual recycling rules as though a valid, 
finite scalar had been inserted instead of NA or +Inf. See the Examples section.

Examples

```r
M <- mondate.mdy(6,30,2008)
year(M) # 2008
month(M) # 6
day(M) # 30

mondate.mdy(2008,6,30) # ditto
mondate.mdy(2008,6)   # ditto; 'day' argument is "missing" so
                      # returns the last day of the month
mondate.mdy(2008,1:12) # all month-ends of 2008, a leapyear
# year-ends 2001 through 2013, displaying only the 4-digit year when shown
mondate.mdy(2001:2013, displayFormat = "%Y")
mondate.mdy(2010:2012, NA) # NA mondate vector of length 3
mondate.mdy(Inf,11,31)  # An infinite mondate even though only 30 days in
                        # November

x <- mondate.mdy(2013, 1:12) # month-ends in 2013
# Give x some shape
dim(x) <- 3:4
dimnames(x) <- list(A = letters[1:3], B = LETTERS[1:4])
# Return the quarter numbers in an array with the same shape and dimnames
quarter(x)
```

Description

Functions to format a mondate into its character representation according to the displayFormat 
property.

Usage

YearQuartersFormat(x)

Arguments

x a mondate or a Date or a POSIXt.
Details

YearQuartersFormat is an example of a special formatting function that can be provided to a mondate object when created. It will represent the date as YYYYQ* where * is 1-4. See Examples.

Examples

b <- mondate(1:12, formatFUN = YearQuartersFormat) # end of first 12 months of 2000
b

Description

Methods to extract portions of a mondate

Usage

## S3 method for class 'mondate'
head(x, ...)
## S3 method for class 'mondate'
tail(x, ...)

Arguments

x a mondate.
...

... See the base functions for details.

Details

Whether the mondate x is shaped as a vector or a matrix, the head and rbind methods will behave just as they would if x were numeric.

Methods

[(x = "mondate") See [ for more details.

Examples

(m<-structure(ymd(2001:2010,12,31),names=LETTERS[1:10]))
m[1]
m[2:5]
head(m)
tail(m,2)

(M<-cbind(m-12,m,m+12, deparse.level=2)) # a matrix
M[1:5,1:2] # '[' works with matrix mondates
head(M,2) # as does 'head'
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