

Package ‘PMwR’

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Description Functions and examples for 'Portfolio Management with R':
backtesting investment and trading strategies, computing
profit/loss and returns, analysing trades, reporting, and more.

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R topics documented:

| | |
|-------------------------|----|
| PMwR-package | 2 |
| Adjust-Series | 3 |
| btest | 4 |
| DAX | 7 |
| instrument | 8 |
| is_valid_ISIN | 9 |
| journal | 10 |
| NAVseries | 13 |

| | |
|------------------------------|-----------|
| pl | 15 |
| plot_trading_hours | 19 |
| position | 21 |
| pricetable | 23 |
| quote32 | 24 |
| rc | 25 |
| rebalance | 27 |
| returns | 29 |
| REXP | 32 |
| scale1 | 32 |
| toHTML | 33 |
| Trade-Analysis | 34 |
| unit_prices | 35 |
| valuation | 37 |
| Index | 39 |

 PMwR-package

Tools for the Management of Financial Portfolios

Description

Functions for the practical management of financial portfolios: backtesting investment and trading strategies, computing profit-and-loss and returns, analysing trades, reporting, and more.

Details

The aim of **PMwR** is to provide a small set of reliable, efficient and convenient tools that help in processing and analysing trade/portfolio data. The Manual provides all the details. It is available from <http://enricoschumann.net/PMwR/>.

Author(s)

Enrico Schumann <es@enricoschumann.net>

References

- Gilli, M., Maringer, D. and Schumann, E. (2011) *Numerical Methods and Optimization in Finance*. Elsevier. <http://www.elsevierdirect.com/product.jsp?isbn=9780123756626>
- Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/PMwR/>

Description

Adjust a time series for dividends and splits.

Usage

```
div_adjust(x, t, div, backward = TRUE, additive = FALSE)
```

```
split_adjust(x, t, ratio, backward = TRUE)
```

Arguments

| | |
|----------|---|
| x | a numeric vector |
| t | an integer vector, specifying the positions in x at which dividends were paid ('ex-days') or at which a split occurred |
| div | a numeric vector, specifying the dividends. If necessary, recycled to the length of t. |
| ratio | a numeric vector, specifying the split ratios. The ratio must be 'American Style': a 2-for-1 stock split, for example, corresponds to a ratio of 2. (In other countries, for instance Germany, a 2-for-1 stock split would be called a 1-for-1 split: you keep your shares and receive one new share per share that you own.) |
| backward | logical |
| additive | logical |

Details

With backward set to TRUE, which is the default, the final prices in the unadjusted series matches the final prices in the adjusted series.

Value

a numeric vector of length equal to length(x)

Author(s)

Enrico Schumann

Examples

```
x <- c(9.777, 10.04, 9.207, 9.406)
div <- 0.7
t <- 3

div_adjust(x, t, div)
div_adjust(x, t, div, FALSE)
```

Description

Testing trading and investment strategies.

Usage

```
btest(prices, signal, do.signal = TRUE, do.rebalance = TRUE,
      print.info = NULL, b = 1L, fraction = 1,
      initial.position = 0, initial.cash = 0,
      final.position = FALSE,
      cashflow = NULL, tc = 0, ...,
      add = FALSE, lag = 1, convert.weights = FALSE, trade.at.open = TRUE,
      tol = 1e-5, Globals = list(),
      prices0 = NULL, include.data = FALSE, timestamp, instrument,
      progressBar = FALSE)
```

Arguments

| | |
|--------------|--|
| prices | For a single asset, a matrix of prices with four columns: open, high, low and close. For n assets, a list of length four: prices[[1]] is then a matrix with n columns containing the open prices for the assets; prices[[2]] is a matrix with the high prices, and so on. If only close prices are used, then for a single asset, either a matrix of one column or a numeric vector; for multiple assets a list of length one, containing the matrix of close prices. (For example, with 100 close prices of 5 assets, the prices should be arranged in a matrix p of size 100 times 5; and prices = list(p).) The series in prices are also used to value the positions that are created. If signals are to be based on other series, then these other series should be passed via the ... argument. |
| signal | A function that evaluates to the position suggested by the trading rule; see Details. |
| do.signal | Logical/numeric vector or function that evaluates to TRUE or FALSE. Default is TRUE: a signal is then computed in every period. When a logical/numeric vector, its length must match the number of observations in prices: so.signal then gives the rows in prices at which a signal is computed. Can also be the string "firstofmonth" or "lastofmonth" or "firstofquarter"; in this case, timestamp needs to be specified and must be coercable to Date . |
| do.rebalance | Same as do.signal. Can also be the string "do.signal", in which case the actual result from do.signal is copied. |
| print.info | A function. If NULL, nothing is printed. See Details. |
| cashflow | A function. Default is NULL. |
| b | burn-in (an integer). Defaults to 1. |

| | |
|-------------------------------|---|
| <code>fraction</code> | amount of rebalancing to be done (a scalar between 0 and 1) |
| <code>initial.position</code> | initial portfolio (a numeric vector). If supplied, this will also be the initial suggested position. |
| <code>initial.cash</code> | a numeric vector of length 1. Defaults to 0. |
| <code>final.position</code> | logical |
| <code>tc</code> | transaction costs as a fraction of turnover (e.g., 0.001 means 0.1%) |
| <code>...</code> | other named arguments. All functions (<code>signal</code> , <code>do.signal</code> , <code>do.rebalance</code> , <code>print.info</code> , <code>cashflow</code>) will have access to these arguments. See Details for reserved argument names. |
| <code>add</code> | Default is FALSE. TRUE is not implemented – but would mean that <code>signal</code> should evaluate to <i>changes</i> in position, i.e., orders. |
| <code>lag</code> | default is 1 |
| <code>convert.weights</code> | Default is FALSE. If TRUE, the value of <code>signal</code> will be considered a weight vector and automatically translated into (fractional) position sizes. |
| <code>trade.at.open</code> | A logical vector of length one; default is TRUE. |
| <code>tol</code> | A numeric vector of length one: only rebalance if the maximum absolute suggested change in any position is greater than <code>tol</code> . Default is 0.00001 (which practically means always rebalance). |
| <code>Globals</code> | A list of named elements. See Details. |
| <code>prices0</code> | A numeric vector (default is NULL). Only used if <code>b</code> is 0 and an initial portfolio (<code>initial.position</code>) is specified. |
| <code>include.data</code> | logical. If TRUE, all passed data are stored in final <code>btest</code> object. (See Value.) |
| <code>timestamp</code> | a vector of timestamps, along prices (optional; mainly used for <code>print</code> method and <code>journal</code>) |
| <code>instrument</code> | character vector of instrument names (optional; mainly used for <code>print</code> method and <code>journal</code>) |
| <code>progressBar</code> | logical: display <code>txtProgressBar</code> ? |

Details

The function provides an accounting framework for trading rules. The basic ingredients are time series in the form of OHLC bars (which need not be equally spaced) and several functions that map these series into positions.

`backtest` runs a loop from `b + 1` to `NROW(prices)`. In iteration `t`, a `signal` can be computed based on information from periods prior to `t`. Trading then takes place at the opening price of `t`. For slow-to-compute signals this is reasonable if there is a time lag between close and open. For daily prices, for instance, signals could be computed overnight. For higher frequencies, such as every second, the signal function should be fast to compute; alternatively, it may be better to use a larger time offset (i.e. use information from periods $\ll t$).

If no OHLC bar are available, a single series (assumed to be close prices) can be passed. In effect, we might then use information up to the close of `t - 1`, and trade at the close of `t`.

The ‘trade logic’ needs to be coded in the function `signal`; arguments to that function should be named and need to be passed with . . .

Reserved argument names are currently these: `Open`, `High`, `Low`, `Close`, `Wealth`, `Cash`, `Time`, `Timestamp`, `Portfolio`, `SuggestedPortfolio`, `Globals`.

`Globals` is special: it is an [environment](#), which can be used to persistently store data during the run of `btest`. Use the argument `Globals` to add initial objects to this list.

Value

A list with class attribute `btest`. The list comprises:

| | |
|----------------------------------|-----------------------------------|
| <code>portfolio</code> | The actual portfolio holdings |
| <code>suggested.portfolio</code> | The suggested holdings |
| <code>cash</code> | cash |
| <code>wealth</code> | total portfolio value |
| <code>cum.tc</code> | transaction costs |
| <code>journal</code> | journal of trades |
| <code>initial.wealth</code> | initial wealth |
| <code>b</code> | burnin |
| <code>final.position</code> | final position |
| <code>Globals</code> | environment <code>Globals</code> |

When `include.data` is `TRUE`, all information (prices, timestamp, instrument, the actual call and functions `signal` etc.) are stored in the list as well.

Author(s)

Enrico Schumann <es@enricoschumann.net>

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/PMwR/>

Examples

```
## For more examples, please see then Manual
## http://enricoschumann.net/R/packages/PMwR/manual/PMwR.html

timestamp <- structure(c(16679L, 16680L, 16681L, 16682L,
                        16685L, 16686L, 16687L, 16688L,
                        16689L, 16692L, 16693L),
                      class = "Date")
prices <- c(3182, 3205, 3272, 3185, 3201,
           3236, 3272, 3224, 3194, 3188, 3213)
data.frame(timestamp, prices)
```

```
signal <- function()    ## buy when last price is
  if (Close() < 3200)  ## below 3200, else sell
    1 else 0           ## (more precisely: build position of 1
                      ## when price < 3200, else reduce
                      ## position to 0)

solution <- btest(prices = prices, signal = signal)
journal(solution)

## with Date timestamps
solution <- btest(prices = prices, signal = signal,
                 timestamp = timestamp)
journal(solution)
```

DAX

DAX

Description

Historical Prices of the DAX.

Usage

```
data("DAX")
```

Format

A data frame with 505 observations on the following variable:

DAX a numeric vector

Details

Close prices.

Examples

```
str(DAX)
```

| | |
|------------|--------------------------------------|
| instrument | <i>Retrieve or Change Instrument</i> |
|------------|--------------------------------------|

Description

Generic function for retrieving and changing instrument information.

Usage

```
instrument(x, ...)
```

Arguments

| | |
|-----|-----------------------------|
| x | an object |
| ... | arguments passed to methods |

Details

Generic function: extract or, if meaningful, replace instrument information

Value

when used to extract instrument, a character vector

Warning

Experimental. The interface may change.

Author(s)

Enrico Schumann

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/R/packages/PMwR/manual/PMwR.html>

See Also

[position](#)

Examples

```
jnl <- journal(instrument = "A",
               amount = 100,
               price = 1)
instrument(jnl)
```

`is_valid_ISIN`*Validate International Securities Identification Numbers (ISINs)*

Description

Check whether a given ISIN is valid.

Usage

```
is_valid_ISIN(isin)
```

Arguments

`isin` a character vector

Details

Checks a character vector of ISINs. The function returns TRUE if the ISIN is valid; else FALSE.

The test procedure in ISO 6166 does not differentiate between cases. Thus, ISINs are transformed to uppercase before being tested.

Value

a logical vector

Author(s)

Enrico Schumann

References

http://en.wikipedia.org/wiki/ISO_6166

<http://www.anna-web.com/index.php/home/isinsaiso6166>

Examples

```
isin <- c("US0378331005", "AU0000XVGZA3",  
         "DE000A0C3743", "not_an_isin")  
is_valid_ISIN(isin)  
  
is_valid_ISIN(c("US0378331005",  
               "us0378331005")) ## case is ignored
```

| | |
|---------|----------------|
| journal | <i>Journal</i> |
|---------|----------------|

Description

Create and manipulate a journal of financial transactions.

Usage

```
journal(amount, ...)

as.journal(x, ...)

is.journal(x)

## Default S3 method:
journal(amount, price, timestamp, instrument,
         id = NULL, account = NULL, ...)

## S3 method for class 'journal'
c(..., recursive = FALSE)

## S3 method for class 'journal'
length(x)

## S3 method for class 'journal'
aggregate(x, by, FUN, ...)

## S3 method for class 'journal'
print(x, ...,
      width = getOption("width"), max.print = getOption("max.print"),
      exclude = NULL, include.only = NULL)

## S3 method for class 'journal'
sort(x, decreasing = FALSE, by = "timestamp", ..., na.last = TRUE)

## S3 method for class 'journal'
subset(x, ...)

## S3 method for class 'journal'
x[i, match.against = NULL,
   ignore.case = TRUE, ..., reverse = FALSE]

## S3 replacement method for class 'journal'
x[i, match.against = NULL,
   ignore.case = TRUE, ..., reverse = FALSE] <- value
```

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

## S3 method for class 'journal'
head(x, n = 6L, ..., by = TRUE)

## S3 method for class 'journal'
tail(x, n = 6L, ..., by = TRUE)
```

Arguments

| | |
|---------------|---|
| timestamp | An atomic vector of mode numeric or character. Timestamps should typically be sortable. |
| amount | numeric |
| price | numeric |
| instrument | character or numeric (though typically character) |
| id | An atomic vector. Default is NULL. |
| account | An atomic vector. default is NULL. |
| ... | For <code>journal</code> : further arguments, which must all be named. For <code>subset</code> : an expression that evaluates to a logical vector. The expression may use all fields of the passed <code>journal</code> ; see <code>Examples</code> . For <code>`[`</code> : arguments other than <code>ignore.case</code> to be passed to <code>grep</code> . For <code>sort</code> : arguments passed to <code>sort</code> . |
| x | a <code>journal</code> or an object to be coerced to class <code>journal</code> (for <code>as.journal</code>) or to be checked if it inherits from <code>journal</code> (for <code>is.journal</code>) |
| width | integer. See <code>options</code> . |
| decreasing | passed to <code>sort</code> |
| by | <code>sort</code> : sort by field. <code>head/tail</code> : by instrument. |
| ignore.case | logical |
| na.last | arguments passed to <code>sort</code> |
| max.print | maximum number of transactions to print |
| exclude | character: fields that should not be printed |
| include.only | character: print only those fields. (Not supported yet.) |
| row.names | see <code>as.data.frame</code> |
| optional | see <code>as.data.frame</code> |
| recursive | ignored (see <code>c</code>) |
| i | integer, logical or character. The latter is interpreted as a regexp (see <code>grep</code>) |
| n | integer. |
| match.against | character vector of field names. Default is NULL, which means to match against all character fields. |

| | |
|---------|--|
| reverse | logical. If TRUE, select journal entries that do not match regular expression. |
| FUN | either a function that takes as input a journal and evaluates to a journal, or a list of named functions |
| value | a replacement value |

Details

The `journal` function creates a list of the arguments and attaches a class attribute (`'journal'`). There are several methods:

`aggregate` Splits a journal according to `by`, applies a function to every sub-journal and recombines the results into a journal.

`split` Splits a journal according to `f`, yielding a list of journals. Often used interactively to have information per sub-journal printed.

`c` Combine several journals into one. Note that the first argument to `c.journal` must inherit from `journal`, or else the method dispatch will fail. For empty journals, use `journal()` (not `NULL`).

`length` number of transactions in a journal; it uses the length of `amount`.

`subset` evaluates an expression in an environment that can access all fields of the journal. The function is meant for interactive analysis; care is needed when it is used within other functions: see Examples and the Manual.

For journals that have a `length`, missing arguments will be coded as `NA` except for `id` and `account`, which become `NULL`. In zero-length (i.e. 'empty') journals, all fields have length 0. A zero-length journal is created, of instance, by saying `journal()` or when an zero-row `data.frame` is passed to `as.journal`.

Value

An object of class `journal`, which is a list of atomic vectors.

Author(s)

Enrico Schumann <es@enricoschumann.net>

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/R/packages/PMwR/>

See Also

[position, pl](#)

Examples

```

j <- journal(timestamp = 1:3,
             amount = c(1,2,3),
             price = 101:103,
             instrument = c("Stock A", "Stock A", "Stock B"))

## *** subset *** in functions
##  this should work as expected ...
t0 <- 2.5
subset(j, timestamp > t0)

##  ... but here?!
tradesAfterT <- function(j, t0)
  subset(j, timestamp > t0)
tradesAfterT(j, 0)

##  if really required
tradesAfterT <- function(j, t0) {
  e <- substitute(timestamp > t0, list(t0 = t0))
  do.call(subset, list(j, e))
}
tradesAfterT(j, 0)

##  ... or much simpler
tradesAfterT <- function(j, t0)
  j[j$timestamp > t0]
tradesAfterT(j, 0)

## *** aggregate ***
##  several buys and sells on two days
##  aim: find average buy/sell price per day
j <- journal(timestamp = structure(c(15950, 15951, 15950, 15951, 15950,
                                15950, 15951, 15951, 15951, 15951),
                                class = "Date"),
            amount = c(-3, -4, -3, -1, 3, -2, 1, 3, 5, 3),
            price = c(104, 102, 102, 110, 106, 104, 104, 106, 108, 107),
            instrument = c("B", "B", "A", "A", "B", "B", "A", "B", "A", "A"))

by <- list(j$instrument, sign(j$amount), as.Date(j$timestamp))
fun <- function(x) {
  journal(timestamp = as.Date(x$timestamp[1]),
          amount = sum(x$amount),
          price = sum(x$amount*x$price)/sum(x$amount),
          instrument = x$instrument[1L])
}
aggregate(j, by = by, FUN = fun)

```

Description

Create a net-asset-value (NAV) series.

Usage

```
NAVseries(NAV, timestamp,
          instrument = NULL, title = NULL, description = NULL)

as.NAVseries(x, ...)

## S3 method for class 'NAVseries'
print(x, ...)

## S3 method for class 'NAVseries'
summary(object, monthly = TRUE, na.rm = FALSE, ... )

## S3 method for class 'NAVseries'
plot(x, y, xlab = "", ylab = "", type = "l", ... )
```

Arguments

| | |
|-------------|---|
| NAV | numeric |
| timestamp | time stamp (typically Date or POSIXct) |
| instrument | character |
| title | character |
| description | character |
| x | an NAVseries or an object to be coerced to NAVseries |
| object | an NAVseries |
| ... | further arguments |
| monthly | if TRUE (default), volatility computations are done on monthly returns |
| na.rm | logical |
| y | a second NAVseries to be plotted. Not supported yet. |
| xlab | character |
| ylab | character |
| type | character. See plot . |

Details

An NAVseries is a numeric vector (the actual series) and additional information, attached as attributes: timestamp, instrument, title, description. Of these attributes, timestamp is the most useful, as it is used for several computations (e.g. when calling [summary](#)) or for plotting.

The summary method returns a list of the original NAVseries plus various statistics, such as return per year and volatility.

Value

an NAVseries: see Details.

Author(s)

Enrico Schumann <es@enricoschumann.net>

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/PMwR/>

See Also

[journal](#)

Examples

```
summary(NAVseries(DAX[[1]], as.Date(row.names(DAX)), title = "DAX"))
```

pl

Profit and Loss

Description

Compute profit and (or) loss of financial transactions.

Usage

```
pl(amount, ...)

## Default S3 method:
pl(amount, price, timestamp = NULL,
    instrument = NULL, multiplier = 1,
    multiplier.regexp = FALSE,
    along.timestamp = FALSE, approx = FALSE,
    initial.position = NULL, initial.price = NULL,
    vprice = NULL, tol = 1e-10, do.warn = TRUE, ...)

## S3 method for class 'journal'
pl(amount, multiplier = 1,
    multiplier.regexp = FALSE,
    along.timestamp = FALSE, approx = FALSE,
    initial.position = NULL, initial.price = NULL,
    vprice = NULL, tol = 1e-10, do.warn = TRUE, ...)

## S3 method for class 'pl'
pl(amount, ...)
```

```
.pl(amount, price, tol = 1e-10, do.warn = TRUE)

## S3 method for class 'pl'
print(x, ..., use.crayon = NULL, na.print = ".")

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

Arguments

| | |
|-------------------|---|
| amount | numeric or a journal |
| price | numeric |
| instrument | character or numeric (though typically character) |
| timestamp | An atomic vector of mode numeric or character . Timestamps should typically be sortable. |
| along.timestamp | a logical |
| initial.position | a position . |
| initial.price | prices to evaluate initial position. |
| vprice | valuation price; a numeric vector. With several instruments, the prices must be named, e.g. <code>c(stock1 = 100, stock2 = 101)</code> . See Details. |
| multiplier | numeric vector. When instrument is specified and the vector is named, the names will be matched against instruments. |
| multiplier.regexp | logical. If TRUE, the names of <code>multiplier</code> are interpreted as regular expressions. See Examples. |
| approx | logical |
| tol | numeric: threshold to consider a position zero. |
| x | a <code>pl</code> object to be printed or to be coerced to a <code>data.frame</code> |
| ... | further argument |
| use.crayon | logical |
| na.print | character: how to print NA values |
| do.warn | logical: issue warnings? |

Details

Computes profit and/or loss and returns a list with several statistics (see Section Value, below). To get only the profit/loss numbers as a numeric vector, call `pl` twice (`pl(pl(...))`).

To use package `crayon` – which is only sensible in interactive use –, either explicitly set `use.crayon` to TRUE or set an option `PMwR.use.crayon` to TRUE.

Using `vprice`: when `along.timestamp` is logical – FALSE (the default) or TRUE –, `vprice` can be used to value an open position. For a single asset, it should be a single number; for several assets, it

should be named vector. When `along.timestamp` is used to pass a custom timestamp: for a single asset, `vprice` must be a vector with the same length as `along.timestamp`; for several assets, it must be a numeric matrix with dimension `length(along.timestamp)` times number of assets.

Value

For `pl`, an object of class `pl`, which is a list of lists: one list for each instrument. Each such list contains numeric vectors: `pl`, `realised`, `unrealised`, `buy`, `sell`, `volume`.

For `.pl`, a numeric vector with four elements: profit/loss in units of the instrument, sum of absolute amounts, average buy price, average sell price.

Author(s)

Enrico Schumann <es@enricoschumann.net>

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/PMwR/>

See Also

[btest](#), [returns](#)

Examples

```
J <- journal(timestamp = c( 1,  2,  3),
              amount   = c( 1,  1, -2),
              price    = c(100, 102, 101))

pl(J)
pl(c(1, 1, -2), c(100,102, 101)) ## without a 'journal'

J <- journal(timestamp = c( 1,  2,  3,  1,  2,  3),
              amount   = c( 1,  1, -2,  1,  1, -2),
              price    = c(100, 102, 101, 100, 102, 105),
              instrument = c(rep("Bond A", 3), rep("Bond B", 3)))

pl(J)
## Bond A
## P/L total      0
## average buy    101
## average sell   101
## cum. volume    4
##
## Bond B
## P/L total      8
## average buy    101
## average sell   105
## cum. volume    4
##
## 'P/L total' is in units of instrument;
```

```

## 'volume' is sum of /absolute/ amounts.

as.data.frame(pl(J))
##      pl buy sell volume
## Bond A  0 101  101     4
## Bond B  8 101  105     4

pl(pl(J)) ## P/L as a numeric vector

## Example for 'vprice'
instrument <- c(rep("Bond A", 2), rep("Bond B", 2))
amount <- c(1, -2, 2, -1)
price <- c(100, 101, 100, 105)

## ... no p/l because positions not closed:
pl(amount, price, instrument = instrument, do.warn = FALSE)

## ... but with vprice specified, p/l is computed:
pl(amount, price, instrument = instrument,
    vprice = c("Bond A" = 103, "Bond B" = 100))

### ... and is, except for volume, the same as here:
instrument <- c(rep("Bond A", 3), rep("Bond B", 3))
amount <- c(1, -2, 1, 2, -1, -1)
price <- c(100, 101, 103, 100, 105, 100)
pl(amount, price, instrument = instrument)

## Example for 'along.timestamp' and 'vprice'
j <- journal(amount = c(1, -1), price = c(100, 101),
             timestamp = as.Date(c("2017-07-05", "2017-07-06")))
pl(j)

pl(j,
    along.timestamp = TRUE)

pl(j,
    along.timestamp = seq(from = as.Date("2017-07-04"),
                          to = as.Date("2017-07-07"),
                          by = "1 day"),
    vprice = 101:104)

## Example for 'multiplier'
jnl <- read.table(textConnection(
"instrument, price, amount
FGBL MAR 16, 165.20, 1
FGBL MAR 16, 165.37, -1

```

```

FGBL JUN 16, 164.12, 1
FGBL JUN 16, 164.13, -1
FESX JUN 16, 2910, 5
FESX JUN 16, 2905, -5"
), header = TRUE, stringsAsFactors = FALSE, sep = ",")

jnl <- as.journal(jnl)
pl(jnl, multiplier.regexp = TRUE, ## regexp matching is case sensitive
  multiplier = c("FGBL" = 1000, "FESX" = 10))

## use package 'crayon'
## Not run:
## on Windows, you may also need 'options(crayon.enabled = TRUE)'
options(PMwR.use.crayon = FALSE)
pl(amount = c(1, -1), price = c(1, 2))
options(PMwR.use.crayon = TRUE)
pl(amount = c(1, -1), price = c(1, 2))

## End(Not run)

```

plot_trading_hours *Plot Time Series During Trading Hours*

Description

Plot a time series after removing weekends and specific times of the day.

Usage

```

plot_trading_hours(x, t = NULL,
  interval = "5 min", labels = "hours", label.format = NULL,
  exclude.weekends = TRUE, holidays = NULL,
  fromHHMMSS = "000000", toHHMMSS = "240000",
  do.plot.axis = TRUE,
  ...,
  from = NULL, to = NULL,
  do.plot = TRUE,
  axis1.par = list())

plotTradingHours(x, t = NULL,
  interval = "5 min", labels = "hours", label.format = NULL,
  exclude.weekends = TRUE, holidays = NULL,
  fromHHMMSS = "000000", toHHMMSS = "240000",
  do.plot.axis = TRUE,
  ...,
  from = NULL, to = NULL,

```

```
do.plot = TRUE,
axis1.par = list())
```

Arguments

| | |
|------------------|--|
| x | A numeric vector. Can also be of class zoo. |
| t | A vector that inherits from class POSIXt. If x inherits from class zoo, then index(x) is used (and any supplied value for t is ignored). |
| interval | A character string like “num units”, in which num is a number, and units is “sec”, “min”, “hour” or “day”. The space between num and units is mandatory. |
| labels | A character vector of length one, determining the grid for plot_trading_hours: can be “hour”, “day”, “dayhour” or “month”. |
| label.format | See strftime . |
| exclude.weekends | logical: default is TRUE |
| holidays | a vector of class Date or a character vector in a format that is understood by as.Date . |
| fromHHMMSS | a character vector of length one in format “HHMMSS” |
| toHHMMSS | a character vector of length one in format “HHMMSS” |
| do.plot.axis | logical. Should axis(1) be plotted? Default is TRUE. |
| ... | parameters passed to plot (and typically par) |
| from | POSIXct: start plot at (if not specified, plot starts at first data point) |
| to | POSIXct: end plot at (if not specified, plot end at last data point) |
| do.plot | logical. Should anything be plotted? Default is TRUE. If FALSE, the function returns a list of points. |
| axis1.par | a list of named elements |

Details

This function is still very **experimental**. In particular, it is recommended that arguments be always named.

Value

A list (invisibly if do.plot is TRUE):

```
list(t, x, axis.pos = pos, axis.labels, timegrid)
```

| | |
|-------------|--|
| t | positions |
| x | values |
| axis.pos | positions of x-tickmarks |
| axis.labels | labels at x-ticks |
| timegrid | a POSIXct vector |
| map | a function. See the manual (a link is under References). |

Author(s)

Enrico Schumann <es@enricoschumann.net>

References

B.D. Ripley and K. Hornik. *Date-Time Classes*. R-News, **1**(2):8–12, 2001.

E. Schumann (2017) *Portfolio Management with R*. <http://enricoschumann.net/PMwR/>

See Also

[DateTimeClasses](#)

Examples

```
t <- as.POSIXct("2012-08-31 08:00:00") + 0:32400
x <- runif(length(t))

par(tck = 0.001, mgp = c(3,1,0.5), bty = "n")
p <- plot_trading_hours(x, t,
  interval = "5 min", labels = "hours",
  xlab = "time", ylab = "random points",
  col = "blue")

## with ?lines
t <- as.POSIXct("2012-08-31 10:00:00") + 0:9000
x <- seq(0, 1, length.out = 9001)
lines(p$map(t)$t, x[p$map(t)$ix], pch = 19)
```

position

Aggregate Transactions to Position

Description

Use information on trades to compute a position at a specific point in time.

Usage

```
position(amount, ...)

## Default S3 method:
position(amount, timestamp, instrument, when,
  drop.zero = FALSE, account = NULL, ...)

## S3 method for class 'position'
print(x, ..., sep = ":")
```

Arguments

| | |
|------------|---|
| when | a timestamp or a vector of timestamps; alternatively, several keywords are supported. See Details. |
| amount | numeric or an object of class journal |
| timestamp | numeric or character: timestamps, must be sortable |
| instrument | character: symbols to identify different instruments |
| account | character: description of account |
| drop.zero | If logical, drop instruments that have a zero position; default is FALSE. If numeric, it is used as a tolerance; e.g., a value of 1-e12 will drop any position whose absolute amount is smaller than 1-e12. |
| x | An object of type position. |
| ... | arguments passed to print |
| sep | A regular expression. Split instruments accordingly. Not implemented yet. |

Details

Only instrument can be specified, so to compute positions on an account basis, paste account to instrument, or split the journal.

The function checks if `timestamp` is sorted (see [is.unsorted](#)) and sorts the journal by `timestamp`, if required. If there are (some) NA values in `timestamp`, but `timestamp` is sorted otherwise, the function will proceed (with a warning, though).

The argument `when` can also be specified as one of several keywords: `last` (or `newest` or `latest`) provides the position at the latest timestamp; `first` (or `oldest`) provides the position at the earliest timestamp; `all` provides the positions at all timestamps in the journal; `endofmonth` provides positions at the end of all calendar months within the timestamp range of the journal. The latter can only work when `timestamp` can be coerced to [Date](#).

Value

An object of class `position`, which is a numeric matrix with `instrument` and `timestamp` attributes. Note that `position` will never drop the result's `dim` attribute; it will always be a matrix of size `length(when) times length(unique(instrument))`.

Author(s)

Enrico Schumann

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/R/packages/PMwR/>

See Also

[journal](#)

Examples

```
position(amount = c(1, 1, -1, 3, -4), timestamp = 1:5, when = 4.9)

## using a journal
J <- journal(timestamp = 1:5, amount = c(1, 1, -1, 3, -4))
position(J, when = 4.9)
```

| | |
|------------|--------------------|
| pricetable | <i>Price Table</i> |
|------------|--------------------|

Description

Create price table

Usage

```
pricetable(price, ...)
```

Arguments

| | |
|-------|--------------------------------------|
| price | a matrix |
| ... | further arguments, passed to methods |

Details

Experimental: interface may change.

pricetable is a helper function for extracting prices of particular instrument at specified dates. For this, it first creates a table that merges series passed via `...` and appends a class attribute. A `[` method then allows to extract prices. Importantly, if you ask for a subset of m rows and n columns, the result will be a matrix of size m times n , even if times or instruments are missing.

pricetable is a generic function, currently with methods for numeric vectors (including vectors with a `dim`, aka matrices) and for `zoo` objects.

Value

a numeric matrix with class attribute pricetable

Author(s)

Enrico Schumann

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/R/packages/PMwR/>

See Also[match](#)**Examples**

```

m <- 3
n <- 2
price <- array(c(1:m, 1:m + 100), dim = c(m,n))
colnames(price) <- LETTERS[1:n]
pt <- pricetable(price, timestamp = 1:m)
##   A   B
## 1 1 101
## 2 2 102
## 3 3 103

pt[ , "A"]
##   A
## 1 1
## 2 2
## 3 3

pt[ , c("X", "A", "X")]
##   x A x
## 1 NA 1 NA
## 2 NA 2 NA
## 3 NA 3 NA

pt[ , c("X", "A", "X"), missing = 0]
##   X A X
## 1 0 1 0
## 2 0 2 0
## 3 0 3 0

pt[c(0, 1.5, 4), , missing = "locf"]
##   A   B
## 0  NA  NA
## 1.5 2 102
## 4   3 103

```

quote32

*Treasury Quotes with 1/32nds of Point***Description**

Print treasury quotes with 1/32nds of points.

Usage

```

quote32(price, sep = "(-|')", warn = TRUE)
q32(price, sep = "(-|')", warn = TRUE)

```


Arguments

| | |
|-------|--------------------------------------|
| price | numeric or character. See Details. |
| sep | character |
| warn | logical. Warn about rounding errors? |

Details

The function is meant for pretty-printing of US treasury bond quotes; it provides no other functionality.

If price is numeric, it is interpreted as a quote in decimal notation and ‘translated’ into a price quoted in fractions of a point.

If price is character, it is interpreted as a quote in fractional notation.

q32 is a short-hand for quote32.

Value

A numeric vector of class quote32.

Author(s)

Enrico Schumann

References

CME Group (2015). *Treasury Futures Price Rounding Conventions*. <http://www.cmegroup.com/education/treasury-futures-price-rounding-conventions.html>

Examples

```
quote32(100 + 17/32 + 0.75/32)
q32("100-172")

q32("100-272") - q32("100-270")
as.numeric(q32("100-272") - q32("100-270"))
```

rc

Return Contribution

Description

Return contribution of portfolio segments.

Usage

```
rc(R, weights, timestamp, segments = NULL)
```

Arguments

| | |
|-----------|---|
| R | returns: a numeric matrix |
| weights | the segment weights: a numeric matrix. <code>weights[i,j]</code> must correspond to <code>R[i,j]</code> |
| timestamp | character or numeric |
| segments | character. If missing, column names of R or of weights are used (if they are not NULL). |

Details

The function computes segment contribution, potentially over time. Returns and weights must be arranged in matrices, with rows corresponding to time periods and columns to portfolio segments. Weights can be missing, in which case R is assumed to already comprise segment returns.

Value

A list of two components

| | |
|----------------------|------------------|
| period_contributions | a data.frame |
| total_contributions | a numeric vector |

Author(s)

Enrico Schumann

References

Feibel, Bruce (2003), *Investment Performance Measurement*, Wiley.

See Also

[returns](#)

Examples

```
weights <- rbind(c( 0.25, 0.75),
                c( 0.40, 0.60),
                c( 0.25, 0.75))

R <- rbind(c( 1 , 0),
           c( 2.5, -1.0),
           c(-2 , 0.5))/100

rc(R, weights, segment = c("equities", "bonds"))
```

| | |
|-----------|----------------------------|
| rebalance | <i>Rebalance Portfolio</i> |
|-----------|----------------------------|

Description

Compute the differences between two portfolios.

Usage

```
rebalance(current, target, price,
          notional = NULL, multiplier = 1,
          truncate = TRUE, match.names = TRUE,
          fraction = 1, drop.zero = FALSE,
          target.weights = TRUE)

## S3 method for class 'rebalance'
print(x, ..., drop.zero = TRUE)

replace_weight(weights, ..., prefix = TRUE, sep = "::")
```

Arguments

| | |
|----------------|---|
| current | the current holdings: a (typically named) vector of position sizes; can also be a position |
| target | the target holdings: a (typically named) vector of weights; can also be a position |
| price | the current prices |
| notional | the value of the portfolio; if missing, replaced by <code>sum(current*prices)</code> |
| multiplier | numeric vector, possibly named |
| truncate | truncate computed positions? Default is TRUE. |
| match.names | logical |
| fraction | numeric |
| x | an object of class <code>rebalance</code> . |
| ... | <code>rebalance</code> : arguments passed to <code>print</code> ; <code>replace_weight</code> : numeric vectors |
| drop.zero | logical; note the different defaults for computing and printing |
| target.weights | logical. If TRUE (the default), the values in <code>target</code> are interpreted as weights. If FALSE, <code>target</code> is interpreted as a position (i.e. notional/number of contracts). |
| weights | a numeric vector with named components |
| sep | character |
| prefix | logical |

Details

The function computes the necessary trades to move from the current portfolio to a target portfolio.

`replace_weight` is a helper function to split baskets into their components. All arguments passed via `...` should be named vectors. If names are not syntactically valid (see `make.names`), quote them. The passed vectors themselves should be passed as named arguments: see examples.

Value

An object of class `rebalance`, which is a `data.frame`:

| | |
|-------------------------|---|
| <code>instrument</code> | character, or NA when <code>match.names</code> is FALSE |
| <code>price</code> | prices |
| <code>current</code> | current portfolio |
| <code>target</code> | new portfolio |
| <code>difference</code> | the difference between current and target |

Attached to the `data.frame` are several attributes:

| | |
|--------------------------|-------------|
| <code>notional</code> | notional |
| <code>match.names</code> | logical |
| <code>multiplier</code> | multipliers |

Author(s)

Enrico Schumann

References

Schumann, E. (2016) *Portfolio Management with R*. <http://enricoschumann.net/R/packages/PMwR/>

See Also

[journal](#)

Examples

```
r <- rebalance(current = c(a = 100, b = 20),
               target  = c(a = 0.2, c = 0.3),
               price   = c(a = 1, b = 2, c = 3))
as.journal(r)

## replace_weight: the passed vectors must be named;
##                  'basket_3' is ignored because not
##                  component of weights is named
##                  'basket_3'
```

```
replace_weight(c(basket_1 = 0.3,
                basket_2 = 0.7),
              basket_1 = c(a = 0.1, b = 0.4, c = .5),
              basket_2 = c(x = 0.1, y = 0.4, z = .5),
              basket_3 = c(X = 0.5, Z = 0.5),
              sep = "|")
```

 returns

Compute Returns

Description

Convert prices into returns.

Usage

```
returns(x, ...)
```

```
## Default S3 method:
```

```
returns(x, t = NULL, period = NULL, complete.first = TRUE, pad = NULL,
        position = NULL, weights = NULL, rebalance.when = NULL,
        lag = 1, ...)
```

```
## S3 method for class 'zoo'
```

```
returns(x, period = NULL, complete.first = TRUE,
        pad = NULL, position = NULL,
        weights = NULL, rebalance.when = NULL, lag = 1, ...)
```

```
## S3 method for class 'p_returns'
```

```
print(x, ..., year.rows = TRUE, month.names = NULL,
        zero.print = "0", plus = FALSE, digits = 1,
        na.print = NULL)
```

```
## S3 method for class 'p_returns'
```

```
toLatex(object, ...,
         year.rows = TRUE, ytd = "YTD", month.names = NULL,
         eol = "\\\\", stand.alone = FALSE)
```

```
## S3 method for class 'p_returns'
```

```
toHTML(x, ...,
        year.rows = TRUE, ytd = "YTD", month.names = NULL,
        stand.alone = TRUE, table.style = NULL, table.class = NULL,
        th.style = NULL, th.class = NULL,
        td.style = "text-align:right; padding:0.5em;",
        td.class = NULL, tr.style = NULL, tr.class = NULL, browse = FALSE)
```

```
.returns(x, pad = NULL, lag)
```

Arguments

| | |
|-----------------------------|--|
| <code>x</code> | a numeric vector (possibly with a <code>dim</code> attribute; ie, a matrix) of prices. Can also be of class <code>zoo</code> , in which case argument <code>t</code> should be <code>NULL</code> . |
| <code>t</code> | timestamps. See argument "period". |
| <code>period</code> | Typically character; supported are "month", "quarter", "year" or "ann" (annualised), "ytd" (year-to-date), "mtd" (month-to-date), "itd" (inception-to-date) or a single year, such as "2012". The value of 'period' is used only when timestamp information is available: for instance, when <code>t</code> is not <code>NULL</code> or with <code>zoo/xts</code> objects. All returns are computed as simple returns. They will only be annualised with option "ann"; they will not be annualised when the length of the time series is less than one year. To force annualising in such a case, use 'ann!'. Annualisation can only work when the timestamp <code>t</code> can be coerced to class <code>Date</code> . The result will have an attribute "is.annualised", which is a logical vector. |
| <code>complete.first</code> | logical. For monthly returns, should the first month (if incomplete) be used. |
| <code>pad</code> | either <code>NULL</code> (no padding of initial lost observation) or a value used for padding (reasonable values might be <code>NA</code> or <code>0</code>) |
| <code>position</code> | numeric; the same length/dimension as <code>x</code> . Deprecated: will be removed in the future. |
| <code>weights</code> | numeric |
| <code>rebalance.when</code> | numeric |
| <code>...</code> | further arguments |
| <code>year.rows</code> | logical. If <code>TRUE</code> (the default), print monthly returns with one row per year. |
| <code>zero.print</code> | character. How to print zero values. |
| <code>na.print</code> | character. How to print NA values. (Not supported yet.) |
| <code>plus</code> | logical. Add a '+' before positive numbers? Default is <code>FALSE</code> . |
| <code>lag</code> | The lag for computing returns. A positive integer, defaults to one; ignored for time-weighted returns or if <code>t</code> is supplied. |
| <code>object</code> | an object of class <code>p_returns</code> ('period returns') |
| <code>month.names</code> | character: names of months |
| <code>digits</code> | number of digits in table |
| <code>ytd</code> | header for YTD |
| <code>eol</code> | character |
| <code>stand.alone</code> | logical or character |
| <code>table.class</code> | character |
| <code>table.style</code> | character |
| <code>th.class</code> | character |
| <code>th.style</code> | character |
| <code>td.class</code> | character |
| <code>td.style</code> | character |
| <code>tr.class</code> | character |
| <code>tr.style</code> | character |
| <code>browse</code> | logical: open table in browser? |

Details

return is a generic function. It computes simple returns: current values divided by prior values minus one. The default method works for numeric vectors/matrices.

Value

If called as `returns(x)`: a numeric vector or matrix, possibly of class `zoo`.

If called with a period argument: an object of class `"p_returns"` (period returns), which is a numeric vector of returns with attributes `t` (timestamp) and `period`. Main use is to have methods that pretty-print such period returns; currently, there are methods for `toLatex` and `toHTML`.

Author(s)

Enrico Schumann

See Also

[bttest](#)

Examples

```
x <- 101:105
returns(x)
returns(x, pad = NA)
returns(x, pad = NA, lag = 2)

## monthly returns
t <- seq(as.Date("2012-06-15"), as.Date("2012-12-31"), by = "1 day")
x <- seq_along(t) + 1000
returns(x, t = t, period = "month")
returns(x, t = t, period = "month", complete.first = FALSE)

### formatting
print(returns(x, t = t, period = "month"), plus = TRUE, digits = 0)

## returns per year (annualised returns)
returns(x, t = t, period = "ann") ## less than one year, not annualised
returns(x, t = t, period = "ann!") ## less than one year, *but* annualised

is.ann <- function(x)
  attr(x, "is.annualised")

is.ann(returns(x, t = t, period = "ann")) ## FALSE
is.ann(returns(x, t = t, period = "ann!")) ## TRUE
```

 REXP

 REXP

Description

Historical Prices of the REXP.

Usage

```
data("REXP")
```

Format

A data frame with 502 observations on the following variable:

REXP a numeric vector

Details

Daily prices.

Examples

```
str(REXP)
```

 scale1

 Scale Time Series

Description

Scale time series so that they can better be compared.

Usage

```
scale1(x, ...)
```

```
## Default S3 method:
```

```
scale1(x, ..., when = "first.complete", level = 1,
       centre = FALSE, scale = FALSE, geometric = TRUE,
       total.g = NULL)
```

```
## S3 method for class 'zoo'
```

```
scale1(x, ..., when = "first.complete", level = 1,
       centre = FALSE, scale = FALSE, geometric = TRUE,
       inflate = NULL, total.g = NULL)
```


Arguments

| | |
|-----------|--|
| x | a time series |
| when | origin: for the default method, either character or numeric (integer). For the zoo method, a value that matches the class of the index of x; for instance, with an index of class <code>Date</code> , when should inherit from <code>Date</code> . |
| level | numeric |
| centre | logical |
| scale | logical or numeric |
| geometric | logical: if TRUE (the default), the geometric mean is deducted with centre is TRUE; if FALSE, the arithmetic mean is used |
| inflate | numeric: an annual rate at which the series is inflated (or deflated if negative) |
| total.g | numeric: to total growth rate (or total return) of a series |
| ... | other arguments passed to methods |

Details

This is a generic function, with methods for numeric vectors and matrices, and zoo objects.

Value

An object of the same type as x.

Author(s)

Enrico Schumann

References

Enrico Schumann – Portfolio Management with R. <http://enricoschumann.net/R/packages/PMwR/manual/PMwR.html>

See Also

[scale](#)

Examples

```
scale1(cumprod(1 + c(0, rnorm(20, sd = 0.02))), level = 100)
```

toHTML

*Import from package **textutils***

Description

The toHTML object is imported from package **textutils**. Help is available here: [textutils::toHTML](#).

Description

Functions to help analyse trades (as opposed to profit-and-loss series)

Usage

```
scale_trades(amount, price, timestamp, aggregate = FALSE,
             fun = NULL, ...)
split_trades(amount, price, timestamp, aggregate = FALSE)

limit(amount, price, timestamp, lim, tol = 1e-8)
scale_to_unity(amount)
close_on_first(amount)

tw_exposure(amount, timestamp, start, end, abs.value = TRUE)
```

Arguments

| | |
|-----------|--|
| amount | notionals |
| price | a vector of prices |
| timestamp | a vector. |
| aggregate | TRUE or FALSE |
| fun | a function |
| lim | a maximum absolute position size |
| start | optional time |
| end | optional time |
| abs.value | logical. If TRUE, the absolute exposure is computed. |
| ... | passed on to fun |
| tol | numeric |

Details

`scale_trades` takes a vector of notionals, prices and scales all trades along the paths so that the maximum exposure is 1.

The default fun divides every element of a vector `n` by `max(abs(cumsum(n)))`. If user-specified, the function `fun` needs to take a vector of notionals (changes in position.)

`split_trades` decomposes a trade list into single trades, where a single trade comprises those trades from a zero position to the next zero position.

Value

Either a list or a list-of-lists.

Author(s)

Enrico Schumann

See Also

[btest](#)

Examples

```
n <- c(1,1,-3,-1,2)
p <- 100 + 1:length(n)
timestamp <- 1:length(n)

split_trades(n, p, timestamp)
split_trades(n, p, timestamp, TRUE) ## almost like the original series

scale_trades(n, p, timestamp)
scale_trades(n, p, timestamp, TRUE) ## each _trade_ gets scaled
```

unit_prices

Compute Prices for Portfolio Based on Units

Description

Compute prices for a portfolio based on outstanding shares.

Usage

```
unit_prices(NAV, cashflows,
            initial.price = 100, initial.shares = 0,
            cf.included = FALSE)
```

Arguments

| | |
|----------------|--|
| NAV | a dataframe of two columns: timestamp and net asset value |
| cashflows | a data.frame of two or three columns: timestamp, cashflow and (optionally) an id |
| initial.price | initial price |
| initial.shares | number of outstanding shares for first NAV |
| cf.included | logical |

Details

The function may be used to compute the P&L for portfolios with external cashflows (i.e. what is usually called time-weighted return).

Valuation (i.e. the computation of the NAV) must take place before external cashflows. Fairness suggests that: what price would you give an external investor if you had not valued the positions? And even if fairness mattered not: suppose we traded on a specific day, had a positive PL, and ended the day in cash. We could then not differentiate any more between a cash increase because of an external inflow and a cash increase because of a profitable trade.

Value

A data.frame

| | |
|--------------|---|
| timestamp | |
| NAV | total NAV |
| price | NAV per share |
| shares | outstanding shares before cashflows, used for valuation |
| cashflow | external cashflows |
| new_shares | shares add/subtracted |
| total_shares | total outstanding shares after cashflows |
| NAV_after_cf | total NAV after cashflows |

Author(s)

Enrico Schumann

References

Schumann, E. (2017) *Portfolio Management with R*. <http://enricoschumann.net/R/packages/PMwR/>

See Also

[pl](#)

Examples

```
NAV <- data.frame(timestamp = seq(as.Date("2017-1-1"),
                                as.Date("2017-1-10"),
                                by = "1 day"),
                 NAV = c(0,101:104,205:209))

cf <- data.frame(timestamp = c(as.Date("2017-1-1"),
                              as.Date("2017-1-5")),
                cashflow = c(100, 100))

unit_prices(NAV, cf)
```

 valuation

Valuation

Description

Valuation of financial objects: map an object into a quantity that is measured in some unit.

Usage

```
valuation(x, ...)

## S3 method for class 'journal'
valuation(x, multiplier = 1, cashflow = function(x) x$amount *
  x$price, flip.sign = TRUE, ...)

## S3 method for class 'position'
valuation(x, multiplier = 1, price.table, do.sum, unit, ...)
```

Arguments

| | |
|-------------|--|
| x | an object |
| multiplier | a numeric vector, typically with named elements |
| cashflow | either a numeric vector or a function that takes on argument (a journal) and transforms it into a numeric vector |
| flip.sign | logical. If TRUE (the default), a positive amount gets mapped into a negative cashflow. |
| price.table | numeric |
| do.sum | logical: sum over positions |
| unit | not implemented |
| ... | other arguments passed to methods |

Details

valuation is a generic function. Its semantics suggest that an object (eg, a financial instrument or a position) is mapped into a concrete quantity (such as an amount of some currency).

Value

depends on the object

Note

Very experimental.

Author(s)

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Examples

```
## ... will be provided when the function has become stable
```

Index

- *Topic **chron**
 - plot_trading_hours, 19
- *Topic **datasets**
 - DAX, 7
 - REXP, 32
- *Topic **hplot**
 - plot_trading_hours, 19
- *Topic **package**
 - PMwR-package, 2
- *Topic **ts**
 - plot_trading_hours, 19
- .pl (pl), 15
- .returns (returns), 29
- [.journal (journal), 10
- [<-.journal (journal), 10

- Adjust-Series, 3
- aggregate.journal (journal), 10
- as.data.frame, 11
- as.data.frame.journal (journal), 10
- as.data.frame.pl (pl), 15
- as.Date, 20
- as.journal (journal), 10
- as.NAVseries (NAVseries), 13

- btest, 4, 17, 31, 35

- c, 11
- c.journal (journal), 10
- character, 16
- close_on_first (Trade-Analysis), 34

- Date, 4, 14, 20, 22, 30, 33
- DateTimeClasses, 21
- DAX, 7
- dim, 23
- div_adjust (Adjust-Series), 3

- environment, 6

- grep, 11

- head.journal (journal), 10

- instrument, 8
- instrument<- (instrument), 8
- is.journal (journal), 10
- is.unsorted, 22
- is_valid_ISIN, 9

- journal, 6, 10, 15, 16, 22, 28

- length.journal (journal), 10
- limit (Trade-Analysis), 34

- make.names, 28
- match, 24

- NA, 12, 30
- NAVseries, 13
- NULL, 12
- numeric, 16

- options, 11

- p_returns (returns), 29
- par, 20
- pl, 12, 15, 36
- plot, 14, 20
- plot.NAVseries (NAVseries), 13
- plot_trading_hours, 19
- plotTradingHours (plot_trading_hours), 19
- PMwR (PMwR-package), 2
- PMwR-package, 2
- position, 8, 12, 16, 21
- POSIXct, 14
- pricetable, 23
- print, 22, 27
- print.journal (journal), 10
- print.NAVseries (NAVseries), 13
- print.p_returns (returns), 29
- print.pl (pl), 15

`print.position` (`position`), 21
`print.rebalance` (`rebalance`), 27

`q32` (`quote32`), 24
`quote32`, 24

`rc`, 25
`rebalance`, 27
`replace_weight` (`rebalance`), 27
`returns`, 17, 26, 29
`REXP`, 32

`scale`, 33
`scale1`, 32
`scale_to_unity` (`Trade-Analysis`), 34
`scale_trades` (`Trade-Analysis`), 34
`sort`, 11
`sort.journal` (`journal`), 10
`split.journal` (`journal`), 10
`split_adjust` (`Adjust-Series`), 3
`split_trades` (`Trade-Analysis`), 34
`strftime`, 20
`subset.journal` (`journal`), 10
`summary`, 14
`summary.NAVseries` (`NAVseries`), 13

`tail.journal` (`journal`), 10
`textutils::toHTML`, 33
`toHTML`, 31, 33
`toHTML.p_returns` (`returns`), 29
`toLatex`, 31
`toLatex.p_returns` (`returns`), 29
`Trade-Analysis`, 34
`tw_exposure` (`Trade-Analysis`), 34
`txtProgressBar`, 5

`unit_prices`, 35

`valuation`, 37

`zoo`, 23