

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, handling lists of transactions, reporting, and more.

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R topics documented:

PMwR-package	2
Adjust-Series	3
btest	4
DAX	8
instrument	8
is_valid_ISIN	9

journal	10
NAVseries	14
pl	15
plot_trading_hours	20
position	22
pricetable	23
quote32	25
rc	26
rebalance	27
returns	29
REXP	32
scale1	33
toHTML	34
Trade-Analysis	34
unit_prices	36
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)
```

btest

*Backtesting Investment Strategies***Description**

Testing trading and investment strategies.

Usage

```
btest(prices, signal,
      do.signal = TRUE, do.rebalance = TRUE,
      print.info = NULL, b = 1, 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 used both as transaction prices and for valuing open positions. If signals are to be based on other series, such 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: do.signal then gives the rows in prices at which a signal is computed. Can also be the string "firstofmonth", "lastofmonth", "firstofquarter" or "lastofquarter"; in these cases, 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 value of do.signal is copied.
print.info	A function or NULL. If NULL, nothing is printed. See Details.
cashflow	A function or NULL (default).

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

Details

The function provides infrastructure for testing trading rules. Essentially, btest does accounting: keep track of transactions and positions, value open positions, etc.

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 and other pieces of information 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 bars are available, a single series per asset (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.

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>	<code>journal</code> 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

## 1 - a simple rule
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)

## 2 - a simple MA model
## Not run:
require("PMwR")
require("NMOF")

dax <- DAX[[1]]

n <- 5
ma <- MA(dax, n, pad = NA)

ma_strat <- function(ma) {
  if (Close() > ma[Time()])
    1
  else
    0
}

plot(as.Date(row.names(DAX)), dax, type = "l", xlab = "", ylab = "DAX")
lines(as.Date(row.names(DAX)), ma, type = "l")

res <- btest(dax, signal = ma_strat,
            b = n, ma = ma)

par(mfrow = c(3,1))
plot(as.Date(row.names(DAX)), dax, type = "l", xlab = "", ylab = "DAX")
plot(as.Date(row.names(DAX)), res$wealth, type = "l", xlab = "", ylab = "Equity")
plot(as.Date(row.names(DAX)), position(res), type = "s", xlab = "", ylab = "Position")

## End(Not run)

```

DAX *Deutscher Aktienindex (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 *Retrieve or Change Instrument*

Description

Generic function for retrieving and changing instrument information.

Usage

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

```
instrument(x, ...) <- value
```

Arguments

x	an object
...	arguments passed to methods
value	an object

Details

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

Value

when used to extract instrument, a character vector

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

Journal

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 Examples. For <code>`[</code> : arguments other than <code>ignore.case</code> to be passed to grep . For <code>sort</code> : arguments passed to sort .
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 options .
decreasing	passed to sort

<code>by</code>	sort: sort by field. head/tail: by instrument.
<code>ignore.case</code>	logical
<code>na.last</code>	arguments passed to sort
<code>max.print</code>	maximum number of transactions to print
<code>exclude</code>	character: fields that should not be printed
<code>include.only</code>	character: print only those fields. (Not supported yet.)
<code>row.names</code>	see as.data.frame
<code>optional</code>	see as.data.frame
<code>recursive</code>	ignored (see c)
<code>i</code>	integer, logical or character. The latter is interpreted as a regexp (see grep)
<code>n</code>	integer.
<code>match.against</code>	character vector of field names. Default is NULL, which means to match against all character fields.
<code>reverse</code>	logical. If TRUE, select journal entries that do not match regular expression.
<code>FUN</code>	either a function that takes as input a journal and evaluates to a journal, or a list of named functions
<code>value</code>	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)

```

NAVseries

Net-Asset-Value (NAV) Series

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

[btest](#), [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, ... )

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

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

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

```

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 multiplier are interpreted as regular expressions. See Examples.
approx	logical
tol	numeric: threshold to consider a position zero.
x	a pl object to be printed or to be coerced to a data.frame
...	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(. . .))).

pl is a generic function: The default input is vectors for amount, price, etc. Alternatively (and often more conveniently), the function may also be called with a [journal](#) or a [data.frame](#) as its input. For data frames, columns must be named amount, price and so on.

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 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())
```

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

Plot a timeseries during specific times of day.

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	<i>Aggregate Transactions to Position</i>
----------	---

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. endofday and endofmonth provide positions at the end of all calendar days and months within the timestamp range of the journal. The latter can only work if 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))`, which may not be obvious from the printed output.

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

Price Table

Description

Create price table

Usage

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

Arguments

<code>price</code>	a matrix
<code>...</code>	further arguments, passed to methods

Details

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: a regular expression
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	<i>Return Contribution</i>
----	----------------------------

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

Rebalance Portfolio

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 target are interpreted as weights. If FALSE, target 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`:

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

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

notional	notional
match.names	logical
multiplier	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'

...	further arguments
year.rows	logical. If TRUE (the default), print monthly returns with one row per year.
zero.print	character. How to print zero values.
na.print	character. How to print NA values. (Not supported yet.)
plus	logical. Add a '+' before positive numbers? Default is FALSE.
lag	The lag for computing returns. A positive integer, defaults to one; ignored for time-weighted returns or if <code>t</code> is supplied.
object	an object of class <code>p_returns</code> ('period returns')
month.names	character: names of months
digits	number of digits in table
ytd	header for YTD
eol	character
stand.alone	logical or character
table.class	character
table.style	character
th.class	character
th.style	character
td.class	character
td.style	character
tr.class	character
tr.style	character
browse	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

[btest](#)

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 be better 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 Date , when should inherit from Date .
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 at [textutils::toHTML](#).

Trade-Analysis

Analysing Trades: Compute Profit/Loss, Resize and more

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	<i>Compute Prices for Portfolio Based on Units</i>
-------------	--

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 returns for a portfolio with external cashflows, i.e. what is usually called time-weighted returns.

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)

Enrico Schumann

Examples

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

Index

- *Topic **chron**
 - plot_trading_hours, 20
- *Topic **datasets**
 - DAX, 8
 - REXP, 32
- *Topic **hplot**
 - plot_trading_hours, 20
- *Topic **package**
 - PMwR-package, 2
- *Topic **ts**
 - plot_trading_hours, 20
 - .pl (pl), 15
 - .returns (returns), 29
 - [.journal (journal), 10
 - [.pricetable (pricetable), 23
 - [<-.journal (journal), 10
- Adjust-Series, 3
- aggregate.journal (journal), 10
- as.data.frame, 12
- as.data.frame.journal (journal), 10
- as.data.frame.pl (pl), 15
- as.Date, 20
- as.journal (journal), 10
- as.NAVseries (NAVseries), 14
- btest, 4, 15, 17, 31, 35
- c, 12
- c.journal (journal), 10
- character, 16
- close_on_first (Trade-Analysis), 34
- data.frame, 17
- Date, 4, 14, 20, 22, 30, 33
- DateTimeClasses, 21
- DAX, 8
- dim, 24
- div_adjust (Adjust-Series), 3
- environment, 6
- grep, 11, 12
- head.journal (journal), 10
- instrument, 8
- instrument<- (instrument), 8
- is.journal (journal), 10
- is.unsorted, 22
- is_valid_ISIN, 9
- journal, 6, 10, 15–17, 22, 23, 29
- length.journal (journal), 10
- limit (Trade-Analysis), 34
- make.names, 28
- match, 24
- NA, 12, 30
- NAVseries, 14
- NULL, 12
- numeric, 16
- options, 11
- p_returns (returns), 29
- par, 20
- pl, 13, 15, 37
- plot, 15, 20
- plot.NAVseries (NAVseries), 14
- plot_trading_hours, 20
- plotTradingHours (plot_trading_hours), 20
- PMwR (PMwR-package), 2
- PMwR-package, 2
- position, 9, 13, 16, 22
- POSIXct, 14
- pricetable, 23
- print, 22, 28
- print.journal (journal), 10
- print.NAVseries (NAVseries), 14

`print.p_returns` (returns), 29
`print.pl` (pl), 15
`print.position` (position), 22
`print.rebalance` (rebalance), 27

`q32` (quote32), 25
`quote32`, 25

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

`scale`, 34
`scale1`, 33
`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`, 15
`summary.NAVseries` (NAVseries), 14

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

`unit_prices`, 36

`valuation`, 37

`zoo`, 24