Package 'HighFreq'

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Title High Frequency Time Series Management

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Author Jerzy Pawlowski (algoquant)

Maintainer Jerzy Pawlowski <jp3900@nyu.edu>

Description Functions for chaining and joining time series, scrubbing bad data, managing time zones and alligning time indices, converting TAQ data to OHLC format, aggregating data to lower frequency, estimating volatility, skew, and higher moments.

License GPL (>= 2)

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VignetteBuilder knitr

LazyData true

Repository GitHub

URL https://github.com/algoquant/HighFreq

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R topics documented:

`agg_regate` *Calculate the aggregation (weighted average) of a statistical estimator over a* `OHLC` *time series.*

Description

Calculate the aggregation (weighted average) of a statistical estimator over a `OHLC` time series.

Usage

```
agg_regate(oh_lc, mo_ment = "run_variance", weight_ed = TRUE, ...)
```

Arguments

`oh_lc`	`OHLC` time series of prices and trading volumes, in `xts` format.
`mo_ment`	`character` string representing function for estimating the moment.
`weight_ed`	`Boolean` should estimate be weighted by the trading volume? (default is `TRUE`)
`...`	additional parameters to the mo_ment function.

Details

The function `agg_regate()` calculates a single number representing the volume weighted average of an estimator over the `OHLC` time series of prices. By default the sum is trade volume weighted.

Value

A single `numeric` value equal to the volume weighted average of an estimator over the time series.

Examples

```
# calculate weighted average variance for SPY (single number)
vari_ance <- agg_regate(oh_lc=SPY, mo_ment="run_variance")
# calculate time series of daily skew estimates for SPY
skew_daily <- apply.daily(x=SPY, FUN=agg_regate, mo_ment="run_skew")
```

extreme_values *Identify extreme values in a single-column* xts *time series.*

Description

Identifies extreme values as those that exceed a multiple of the rolling volatility.

Usage

```
extreme_values(x_ts, win_dow = 51, vol_mult = 2)
```

Arguments

x_ts	single-column xts time series.
win_dow	number of data points for estimating rolling volatility.
vol_mult	volatility multiplier.

Details

Calculates the rolling volatility as a quantile of values over a rolling window. Extreme values are those that exceed the product of the volatility multiplier times the rolling volatility. Extreme values are the very tips of the tails when the distribution of values becomes very fat-tailed. The volatility multiplier vol_mult controls the threshold at which values are identified as extreme. Smaller volatility multiplier values will cause more values to be identified as extreme.

Value

A Boolean vector with the same number of rows as input time series.

Examples

```
# create local copy of SPY TAQ data
ta_q <- SPY_TAQ
# scrub quotes with suspect bid-offer spreads
bid_offer <- ta_q[, "Ask.Price"] - ta_q[, "Bid.Price"]
sus_pect <- extreme_values(bid_offer, win_dow=win_dow, vol_mult=vol_mult)
# remove suspect values
ta_q <- ta_q[!sus_pect]
```

hf_data *High frequency data sets*

Description

hf_data.RData is a file containing the datasets:

SPY an xts time series containing 1-minute OHLC bar data for the SPY etf, from 2008-01-02 to 2014-05-19. SPY contains 625,425 rows of data, each row contains a single minute bar.

TLT an xts time series containing 1-minute OHLC bar data for the TLT etf, up to 2014-05-19.

VXX an xts time series containing 1-minute OHLC bar data for the VXX etf, up to 2014-05-19.

Usage

```
data(hf_data)  # not required - data is lazy load
```

Format

Each `xts` time series contains `OHLC` data, with each row containing a single minute bar:

Open Open price in the bar

High High price in the bar

Low Low price in the bar

Close Close price in the bar

Volume trading volume in the bar

Source

https://wrds-web.wharton.upenn.edu/wrds/

References

Wharton Research Data Service (WRDS)

Examples

```
# data(hf_data)  # not required - data is lazy load
head(SPY)
chart_Series(x=SPY["2009"])
```

`price_jumps` *Identify isolated price jumps in a single-column* `xts` *time series of prices, based on pairs of large neighboring returns of opposite sign.*

Description

Identify isolated price jumps in a single-column `xts` time series of prices, based on pairs of large neighboring returns of opposite sign.

Usage

```
price_jumps(x_ts, win_dow = 51, vol_mult = 2)
```

Arguments

`x_ts`	single-column `xts` time series of prices.
`win_dow`	number of data points for estimating rolling volatility.
`vol_mult`	volatility multiplier.

Details

Isolated price jumps are single prices that are very different from neighboring values. Price jumps create pairs of large neighboring returns of opposite sign. The function `price_jumps()` first calculates simple returns from prices. Then it calculates the rolling volatility of returns as a quantile of returns over a rolling window. Jump prices are identified as those where neighboring returns both exceed a multiple of the rolling volatility, but the sum of those returns doesn't exceed it.

Value

A `Boolean` vector with the same number of rows as input time series.

Examples

```
# create local copy of SPY TAQ data
ta_q <- SPY_TAQ
# calculate mid prices
mid_prices <- 0.5 * (ta_q[, "Bid.Price"] + ta_q[, "Ask.Price"])
# replace whole rows containing suspect price jumps with NA, and perform locf()
ta_q[price_jumps(mid_prices, win_dow=31, vol_mult=1.0), ] <- NA
ta_q <- na.locf(ta_q)
```

`random_ohlc` *Calculate a random* `OHLC` *time series of prices and trading volumes, in* `xts` *format.*

Description

Calculate a random `OHLC` time series of prices and trading volumes, either by generating random log-normal prices, or by randomly sampling from an input time series.

Usage

```
random_ohlc(oh_lc = NULL, re_duce = TRUE, ...)
```

Arguments

`oh_lc`	`OHLC` time series of prices and trading volumes, in `xts` format.
`re_duce`	`Boolean` should `oh_lc` time series be transformed to reduced form? (default is `TRUE`)

Details

If the input `oh_lc` time series is `NULL` (the default), then a synthetic minutely `OHLC` time series of random log-normal prices is calculated, over the two previous calendar days. If the input `oh_lc` time series is not `NULL`, then the rows of `oh_lc` are randomly sampled, to produce a random time series. If `re_duce` is `TRUE` (the default), then the `oh_lc` time series is first transformed to reduced form, then randomly sampled, and finally converted to standard form. Note: randomly sampling from an intraday time series over multiple days will cause the overnight price jumps to be re-arranged into intraday price jumps. This will cause moment estimates to become inflated compared to the original time series.

Value

An xts time series with the same dimensions and the same time index as the input oh_lc time series.

Examples

```
# create minutely synthetic OHLC time series of random prices
oh_lc <- HighFreq::random_ohlc()
# create random time series from SPY by randomly sampling it
oh_lc <- HighFreq::random_ohlc(oh_lc=SPY["2012-02-13/2012-02-15"])
```

---

random_taq *Calculate a random* TAQ *time series of prices and trading volumes, in* xts *format.*

Description

Calculate a TAQ time series of prices and trading volumes, using random log-normal prices and a time index.

Usage

```
random_taq(in_dex = seq(from = as.POSIXct(paste(Sys.Date() - 3, "09:30:00")),
  to = as.POSIXct(paste(Sys.Date() - 1, "16:00:00")), by = "1 sec"),
  bid_offer = 0.001, ...)
```

Arguments

in_dex	time index for the TAQ time series.
bid_offer	the bid-offer spread expressed as a fraction of the prices. The default value is equal to 0.001 (10bps).

Details

The function random_taq() calculates an xts time series with four columns containing random log-normal prices: the bid, ask, and trade prices, and the trade volume. If in_dex isn't supplied as an argument, then by default it's equal to the secondly index over the two previous calendar days.

Value

An xts time series, with time index equal to the input in_dex time index, and with four columns containing the bid, ask, and trade prices, and the trade volume.

Examples

```
# create secondly TAQ time series of random prices
ta_q <- HighFreq::random_taq()
# create random TAQ time series from SPY index
ta_q <- HighFreq::random_taq(in_dex=SPY["2012-02-13/2012-02-15"])
```

roll_apply *Apply an aggregation function over a rolling lookback window and the end points of an* OHLC *time series.*

Description

Apply an aggregation function over a rolling lookback window and the end points of an OHLC time series.

Usage

```
roll_apply(oh_lc, agg_fun = "run_variance", win_dow = 11,
  end_points = (0:NROW(oh_lc)), by_columns = FALSE, ...)
```

Arguments

oh_lc	OHLC time series of prices and trading volumes, in xts format.
agg_fun	character string representing an aggregation function to be applied over a rolling lookback window.
win_dow	the size of the lookback window, equal to the number of bars of data used for applying the aggregation function.
end_points	an integer vector of end points.
by_columns	Boolean should the function agg_fun() be applied column-wise (individually), or should it be applied to all the columns combined? (default is FALSE)
...	additional parameters to the agg_fun function.

Details

The function roll_apply() applies an aggregation function over a rolling lookback window and the end points of an OHLC time series.

Performs similar operations to the functions rollapply() and period.apply() from package xts, and also the function apply.rolling() from package PerformanceAnalytics. (The function rollapply() isn't exported from the package xts.)

But the function roll_apply() is faster because it performs less type-checking and other overhead. Unlike the other functions, roll_apply() doesn't produce any leading NA values.

The function roll_apply() can be called in two different ways, depending on the argument end_points. If the argument end_points isn't explicitly passed to roll_apply(), then the default value is used, and roll_apply() performs aggregations over overlapping windows at each point in time. If the argument end_points is explicitly passed to roll_apply(), then roll_apply() performs aggregations over overlapping windows spanned by the end_points.

The aggregation function agg_fun can return either a single value or a vector of values. If the aggregation function agg_fun returns a single value, then roll_apply() returns an xts time series with a single column. If the aggregation function agg_fun returns a vector of values, then roll_apply() returns an xts time series with multiple columns equal to the length of the vector returned by the aggregation function agg_fun.

Value

An xts time series with the same number of rows as the argument oh_lc.

Examples

```
# extract a single day of SPY data
x_ts <- SPY["2012-02-13"]
win_dow <- 11
# calculate the rolling sums of the columns of x_ts
agg_regations <- roll_apply(x_ts, agg_fun=sum, win_dow=win_dow, by_columns=TRUE)
# apply a vector-valued aggregation function over a rolling window
agg_function <- function(x_ts)  c(max(x_ts[, 2]), min(x_ts[, 3]))
agg_regations <- roll_apply(x_ts, agg_fun=agg_function, win_dow=win_dow)
# define end points at 11-minute intervals (SPY is minutely bars)
end_points <- rutils::end_points(x_ts, inter_val=win_dow)
# calculate the rolling sums of the columns of x_ts over end_points
agg_regations <- roll_apply(x_ts, agg_fun=sum, win_dow=2, end_points=end_points, by_columns=TRUE)
# apply a vector-valued aggregation function over the end_points of x_ts
agg_regations <- roll_apply(x_ts, agg_fun=agg_function, win_dow=2, end_points=end_points)
```

`roll_hurst` *Calculate the rolling Hurst exponent over a rolling lookback window or the end points of an* `OHLC` *time series.*

Description

Calculate the rolling Hurst exponent over a rolling lookback window or the end points of an `OHLC` time series.

Usage

```
roll_hurst(oh_lc, win_dow = 11, off_set = 0, roll_end_points = FALSE)
```

Arguments

`oh_lc`	an `OHLC` time series of prices in `xts` format.
`win_dow`	the size of the lookback window, equal to the number of bars of data used for aggregating the `OHLC` prices.
`off_set`	the number of bars of data in the first, stub window.
`roll_end_points`	`Boolean` should the Hurst exponent be calculated using aggregations over the end points, or by rolling over a lookback window? (default is `FALSE`)

Details

The function `roll_hurst()` calculates the rolling Hurst exponent in two different ways, depending on the argument `roll_end_points`.

If `roll_end_points` is `FALSE` (the default), then the rolling Hurst exponent is calculated as the logarithm of the ratios of two rolling price range estimates. The Hurst exponent is defined as the logarithm of the ratio of the range of aggregated prices, divided by the average range of prices in each bar. The aggregated prices are calculated over overlapping windows, and the Hurst exponent values are calculated at each point in time.

If `roll_end_points` is `TRUE`, then the rolling Hurst exponent is calculated as the logarithm of the ratios of two rolling variance estimates. The Hurst exponent is defined as the logarithm of the

ratio of the variance of aggregated returns, divided by the variance of simple returns. The aggregated returns are calculated over non-overlapping windows spanned by the end points, using the function `to_period()`. The Hurst exponent values are calculated only at the end points. The non-overlapping aggregation windows can be shifted by using the argument `off_set`, which produces a slightly different series of rolling hurst exponent values.

Value

An `xts` time series with a single column and the same number of rows as the argument `oh_lc`.

Examples

```
# calculate rolling Hurst over SPY
hurst_rolling <- roll_hurst(oh_lc=SPY, win_dow=10)
# calculate Hurst over end points of SPY
hurst_rolling <- roll_hurst(oh_lc=SPY, win_dow=10, off_set=0, roll_end_points=TRUE)
# calculate a series of rolling hurst values using argument off_set
hurst_rolling <- lapply(0:9, roll_hurst, oh_lc=SPY, win_dow=10, roll_end_points=TRUE)
hurst_rolling <- rutils::do_call_rbind(hurst_rolling)
# remove daily warmup periods
hurst_rolling <- hurst_rolling["T09:41:00/T16:00:00"]
chart_Series(x=hurst_rolling["2012-02-13"],
  name=paste(colnames(hurst_rolling), "10-minute aggregations"))
```

`roll_moment` *Calculate a vector of statistics over an* `OHLC` *time series, and calculate a rolling mean over the statistics.*

Description

Calculate a vector of statistics over an `OHLC` time series, and calculate a rolling mean over the statistics.

Usage

```
roll_moment(oh_lc, mo_ment = "run_variance", win_dow = 11,
  weight_ed = TRUE, ...)
```

Arguments

`oh_lc`	`OHLC` time series of prices and trading volumes, in `xts` format.
`mo_ment`	`character` string representing a function for estimating statistics of a single bar of `OHLC` data, such as volatility, skew, and higher moments.
`win_dow`	the size of the lookback window, equal to the number of bars of data used for calculating the rolling mean.
`weight_ed`	`Boolean` should statistic be weighted by trade volume? (default `TRUE`)
`...`	additional parameters to the mo_ment function.

Details

The function `roll_moment()` calculates a vector of statistics over an `OHLC` time series, such as volatility, skew, and higher moments. The statistics could also be any other aggregation of a single bar of `OHLC` data, for example the `High` price minus the `Low` price squared. The length of the vector of statistics is equal to the number of rows of the argument `oh_lc`. Then it calculates a trade volume weighted rolling mean over the vector of statistics over and calculate statistics.

Value

An `xts` time series with a single column and the same number of rows as the argument `oh_lc`.

Examples

```
# calculate time series of rolling variance and skew estimates
var_rolling <- roll_moment(oh_lc=SPY, win_dow=21)
skew_rolling <- roll_moment(oh_lc=SPY, mo_ment="run_skew", win_dow=21)
skew_rolling <- skew_rolling/(var_rolling)^(1.5)
skew_rolling[1, ] <- 0
skew_rolling <- na.locf(skew_rolling)
```

`roll_sharpe` *Calculate the rolling Sharpe ratio over a rolling lookback window for an* `OHLC` *time series.*

Description

Calculate the rolling Sharpe ratio over a rolling lookback window for an `OHLC` time series.

Usage

```
roll_sharpe(oh_lc, win_dow = 11)
```

Arguments

`oh_lc`	an `OHLC` time series of prices in `xts` format.
`win_dow`	the size of the lookback window, equal to the number of bars of data used for aggregating the `OHLC` prices.

Details

The function `roll_sharpe()` calculates the rolling Sharpe ratio as the ratio of absolute returns over the lookback window (not percentage returns), divided by the average volatility of returns.

Value

An `xts` time series with a single column and the same number of rows as the argument `oh_lc`.

Examples

```
# calculate rolling Sharpe ratio over SPY
sharpe_rolling <- roll_sharpe(oh_lc=SPY, win_dow=10)
```

`roll_vwap` *Calculate the volume-weighted average price of an* `OHLC` *time series over a rolling window (lookback period).*

Description

Performs the same operation as function `VWAP()` from package VWAP, but using vectorized functions, so it's a little faster.

Usage

```
roll_vwap(oh_lc, x_ts = oh_lc[, 4], win_dow)
```

Arguments

`oh_lc`	an `OHLC` time series of prices in `xts` format.
`x_ts`	single-column `xts` time series.
`win_dow`	the size of the lookback window, equal to the number of bars of data used for calculating the average price.

Details

The function `roll_vwap()` calculates the volume-weighted average closing price, defined as the sum of the prices multiplied by trading volumes in the lookback window, divided by the sum of trading volumes in the window. If the argument `x_ts` is passed in explicitly, then its volume-weighted average value over time is calculated.

Value

An `xts` time series with a single column and the same number of rows as the argument `oh_lc`.

Examples

```
# calculate and plot rolling volume-weighted average closing prices (VWAP)
prices_rolling <- roll_vwap(oh_lc=SPY["2013-11"], win_dow=11)
chart_Series(SPY["2013-11-12"], name="SPY prices")
add_TA(prices_rolling["2013-11-12"], on=1, col="red", lwd=2)
legend("top", legend=c("SPY prices", "VWAP prices"),
bg="white", lty=c(1, 1), lwd=c(2, 2),
col=c("black", "red"), bty="n")
# calculate running returns
returns_running <- run_returns(x_ts=SPY)
# calculate the rolling volume-weighted average returns
roll_vwap(oh_lc=SPY, x_ts=returns_running, win_dow=11)
```

run_returns — *Calculate single period returns from either* TAQ *or* OHLC *prices.*

Description

Calculate single period returns from either TAQ or OHLC prices.

Usage

```
run_returns(x_ts, col_umn = 4)
```

Arguments

x_ts	xts time series of either TAQ or OHLC data.
col_umn	the column number to extract from the OHLC data. (default is 4, or the close prices column)

Details

Calculates single period returns for either TAQ or OHLC data, as the ratio of the differenced prices divided by the time index differences. Identifies the x_ts time series as TAQ data when it has six columns, otherwise assumes it's OHLC data. By default, for OHLC data, it differences the close prices, but can also difference other prices depending on the value of col_umn.

Value

A single-column xts time series of returns.

Examples

```
# calculate close to close returns
re_turns <- HighFreq::run_returns(x_ts=SPY)
# calculate open to open returns
re_turns <- HighFreq::run_returns(x_ts=SPY, col_umn=1)
```

run_sharpe — *Calculate time series of Sharpe-like statistics for each bar of a* OHLC *time series.*

Description

Calculate time series of Sharpe-like statistics for each bar of a OHLC time series.

Usage

```
run_sharpe(oh_lc, calc_method = "close")
```

Arguments

oh_lc	an OHLC time series of prices in xts format.
calc_method	character string representing method for estimating the Sharpe-like exponent.

Details

The function run_sharpe() calculates Sharpe-like statistics for each bar of a OHLC time series. The Sharpe-like statistic is defined as the ratio of the difference between Close minus Open prices divided by the difference between High minus Low prices. This statistic may also be interpreted as something like a Hurst exponent for a single bar of data. The motivation for the Sharpe-like statistic is the notion that if prices are trending in the same direction inside a given time bar of data, then this statistic is close to either 1 or -1.

Value

An xts time series with the same number of rows as the argument oh_lc.

Examples

```
# calculate time series of running Sharpe ratios for SPY
sharpe_running <- run_sharpe(SPY)
```

---

run_skew *Calculate time series of skew estimates from a OHLC time series, assuming zero drift.*

Description

Calculate time series of skew estimates from a OHLC time series, assuming zero drift.

Usage

```
run_skew(oh_lc, calc_method = "rogers_satchell")
```

Arguments

oh_lc	an OHLC time series of prices in xts format.
calc_method	character string representing method for estimating skew.

Details

The function run_skew() calculates a time series of skew estimates from OHLC prices, one for each bar of OHLC data. The skew estimates are scaled to the time scale of the index of the OHLC time series. For example, if the time index is in seconds, then the estimates are equal to the skew per second, if the time index is in days, then the estimates are equal to the skew per day. Currently only the "close" skew estimation method is correct (assuming zero drift), while the "rogers_satchell" method produces a skew-like indicator, proportional to the skew. The default method is "rogers_satchell".

Value

A time series of skew estimates.

Examples

```
# calculate time series of skew estimates for SPY
sk_ew <- HighFreq::run_skew(SPY)
```

`run_variance` *Calculate a time series of variance estimates for an* `OHLC` *time series, assuming zero drift.*

Description

Calculates the variance estimates for each bar of `OHLC` prices at each point in time (row), using the squared differences of `OHLC` prices at each point in time.

Usage

```
run_variance(oh_lc, calc_method = "yang_zhang")
```

Arguments

`oh_lc`	an `OHLC` time series of prices in `xts` format.
`calc_method`	`character` string representing method for estimating variance. The methods include: • "close" close to close, • "garman_klass" Garman-Klass, • "garman_klass_yz" Garman-Klass with account for close-to-open price jumps, • "rogers_satchell" Rogers-Satchell, • "yang_zhang" Yang-Zhang, (default is `"yang_zhang"`)

Details

The function `run_variance()` calculates a time series of variance estimates from `OHLC` prices, one for each bar of `OHLC` data.

The user can choose from several different variance estimation methods. The methods `"close"`, `"garman_klass_yz"`, and `"yang_zhang"` do account for close-to-open price jumps, while the methods `"garman_klass"` and `"rogers_satchell"` do not account for close-to-open price jumps. The default method is `"yang_zhang"`, which theoretically has the lowest standard error among unbiased estimators. All the methods are implemented assuming zero drift, for two reasons. First, the drift in daily or intraday data is insignificant compared to the volatility. Second, the purpose of the function `run_variance()` is to produce technical indicators, rather than statistical estimates.

The variance is scaled to the scale of the time index of the `OHLC` time series. For example, if the time index is in seconds, then the variance is expressed in units equal to the variance per second, if the time index is in days, then the variance is equal to the variance per day. The function `run_variance()` performs a similar operation to the function `volatility()` from package TTR, but it assumes zero drift, and doesn't calculate a running sum using `runSum()`. It's also a little faster because it performs less data validation.

Value

An `xts` time series with a single column and the same number of rows as the argument `oh_lc`.

Examples

```
# create minutely OHLC time series of random prices
oh_lc <- HighFreq::random_ohlc()
# calculate variance estimates for oh_lc
var_running <- HighFreq::run_variance(oh_lc)
# calculate variance estimates for SPY
var_running <- HighFreq::run_variance(SPY, calc_method="yang_zhang")
# calculate SPY variance without overnight jumps
var_running <- HighFreq::run_variance(SPY, calc_method="rogers_satchell")
```

`save_rets` *Load, scrub, aggregate, and rbind multiple days of* `TAQ` *data for a single symbol. Calculate returns and save them to a single '*`*.RData`*' file.*

Description

Load, scrub, aggregate, and rbind multiple days of `TAQ` data for a single symbol. Calculate returns and save them to a single '`*.RData`' file.

Usage

```
save_rets(sym_bol, data_dir = "E:/mktdata/sec/",
  output_dir = "E:/output/data/", win_dow = 51, vol_mult = 2,
  period = "minutes", tzone = "America/New_York")
```

Arguments

`sym_bol`	`character` string representing symbol or ticker.
`data_dir`	`character` string representing directory containing input '`*.RData`' files.
`output_dir`	`character` string representing directory containing output '`*.RData`' files.
`win_dow`	number of data points for estimating rolling volatility.
`vol_mult`	volatility multiplier.
`period`	aggregation period.
`tzone`	timezone to convert.

Details

The function `save_rets` loads multiple days of `TAQ` data, then scrubs, aggregates, and rbinds them into a `OHLC` time series. It then calculates returns using function `run_returns`, and stores them in a variable named '`symbol.rets`', and saves them to a file called '`symbol.rets.RData`'. The `TAQ` data files are assumed to be stored in separate directories for each '`symbol`'. Each '`symbol`' has its own directory (named '`symbol`') in the '`data_dir`' directory. Each '`symbol`' directory contains multiple daily '`*.RData`' files, each file containing one day of `TAQ` data.

Value

A time series of returns and volume in `xts` format.

Examples

```
## Not run:
save_rets("SPY")

## End(Not run)
```

---

save_rets_ohlc *Load* OHLC *time series data for a single symbol, calculate its returns, and save them to a single '*.RData*' file, without aggregation.*

Description

Load OHLC time series data for a single symbol, calculate its returns, and save them to a single '*.RData' file, without aggregation.

Usage

```
save_rets_ohlc(sym_bol, data_dir = "E:/output/data/",
  output_dir = "E:/output/data/")
```

Arguments

sym_bol	character string representing symbol or ticker.
data_dir	character string representing directory containing input '*.RData' files.
output_dir	character string representing directory containing output '*.RData' files.

Details

The function save_rets_ohlc() loads OHLC time series data from a single file. It then calculates returns using function run_returns, and stores them in a variable named 'symbol.rets', and saves them to a file called 'symbol.rets.RData'.

Value

A time series of returns and volume in xts format.

Examples

```
## Not run:
save_rets_ohlc("SPY")

## End(Not run)
```

save_scrub_agg *Load, scrub, aggregate, and rbind multiple days of* TAQ *data for a single symbol, and save the* OHLC *time series to a single '*.RData*' file.*

Description

Load, scrub, aggregate, and rbind multiple days of TAQ data for a single symbol, and save the OHLC time series to a single '*.RData' file.

Usage

```
save_scrub_agg(sym_bol, data_dir = "E:/mktdata/sec/",
  output_dir = "E:/output/data/", win_dow = 51, vol_mult = 2,
  period = "minutes", tzone = "America/New_York")
```

Arguments

sym_bol	character string representing symbol or ticker.
data_dir	character string representing directory containing input '*.RData' files.
output_dir	character string representing directory containing output '*.RData' files.
win_dow	number of data points for estimating rolling volatility.
vol_mult	volatility multiplier.
period	aggregation period.
tzone	timezone to convert.

Details

The function save_scrub_agg() loads multiple days of TAQ data, then scrubs, aggregates, and rbinds them into a OHLC time series, and finally saves it to a single '*.RData' file. The OHLC time series is stored in a variable named 'symbol', and then it's saved to a file named 'symbol.RData' in the 'output_dir' directory. The TAQ data files are assumed to be stored in separate directories for each 'symbol'. Each 'symbol' has its own directory (named 'symbol') in the 'data_dir' directory. Each 'symbol' directory contains multiple daily '*.RData' files, each file containing one day of TAQ data.

Value

An OHLC time series in xts format.

Examples

```
## Not run:
# set data directories
data_dir <- "C:/Develop/data/hfreq/src/"
output_dir <- "C:/Develop/data/hfreq/scrub/"
sym_bol <- "SPY"
# aggregate SPY TAQ data to 15-min OHLC bar data, and save the data to a file
save_scrub_agg(sym_bol=sym_bol, data_dir=data_dir, output_dir=output_dir, period="15 min")

## End(Not run)
```

save_taq *Load and scrub multiple days of* TAQ *data for a single symbol, and save it to multiple '*.RData*' files.*

Description

Load and scrub multiple days of TAQ data for a single symbol, and save it to multiple '*.RData' files.

Usage

```
save_taq(sym_bol, data_dir = "E:/mktdata/sec/",
  output_dir = "E:/output/data/", win_dow = 51, vol_mult = 2,
  tzone = "America/New_York")
```

Arguments

sym_bol	character string representing symbol or ticker.
data_dir	character string representing directory containing input '*.RData' files.
output_dir	character string representing directory containing output '*.RData' files.
win_dow	number of data points for estimating rolling volatility.
vol_mult	volatility multiplier.
tzone	timezone to convert.

Details

The function save_taq() loads multiple days of TAQ data, scrubs it, and saves the scrubbed TAQ data to individual '*.RData' files. It uses the same file names for output as the input file names. The TAQ data files are assumed to be stored in separate directories for each 'symbol'. Each 'symbol' has its own directory (named 'symbol') in the 'data_dir' directory. Each 'symbol' directory contains multiple daily '*.RData' files, each file containing one day of TAQ data.

Value

A TAQ time series in xts format.

Examples

```
## Not run:
save_taq("SPY")

## End(Not run)
```

scrub_agg *Scrub a single day of* TAQ *data, aggregate it, and convert to* OHLC *format.*

Description

Scrub a single day of TAQ data, aggregate it, and convert to OHLC format.

Usage

```
scrub_agg(ta_q, win_dow = 51, vol_mult = 2, period = "minutes",
  tzone = "America/New_York")
```

Arguments

ta_q	TAQ time series in xts format.
win_dow	number of data points for estimating rolling volatility.
vol_mult	volatility multiplier.
period	aggregation period.
tzone	timezone to convert.

Details

The function scrub_agg() performs:

- index timezone conversion,
- data subset to trading hours,
- removal of duplicate time stamps,
- scrubbing of quotes with suspect bid-offer spreads,
- scrubbing of quotes with suspect price jumps,
- cbinding of mid prices with volume data,
- aggregation to OHLC using function to.period from package xts,

Valid 'period' character strings include: "minutes", "3 min", "5 min", "10 min", "15 min", "30 min", and "hours". The time index of the output time series is rounded up to the next integer multiple of 'period'.

Value

A OHLC time series in xts format.

Examples

```
# create random TAQ prices
ta_q <- HighFreq::random_taq()
# aggregate to ten minutes OHLC data
oh_lc <- HighFreq::scrub_agg(ta_q, period="10 min")
chart_Series(oh_lc, name="random prices")
# scrub and aggregate a single day of SPY TAQ data to OHLC
oh_lc <- HighFreq::scrub_agg(ta_q=SPY_TAQ)
chart_Series(oh_lc, name=sym_bol)
```

scrub_taq *Scrub a single day of* TAQ *data in* xts *format, without aggregation.*

Description

Scrub a single day of TAQ data in xts format, without aggregation.

Usage

```
scrub_taq(ta_q, win_dow = 51, vol_mult = 2, tzone = "America/New_York")
```

Arguments

ta_q	TAQ time series in xts format.
win_dow	number of data points for estimating rolling volatility.
vol_mult	volatility multiplier.
tzone	timezone to convert.

Details

The function scrub_taq() performs the same scrubbing operations as scrub_agg, except it doesn't aggregate, and returns the TAQ data in xts format.

Value

A TAQ time series in xts format.

Examples

```
ta_q <- HighFreq::scrub_taq(ta_q=SPY_TAQ, win_dow=11, vol_mult=1)
# create random TAQ prices and scrub them
ta_q <- HighFreq::random_taq()
ta_q <- HighFreq::scrub_taq(ta_q=ta_q)
ta_q <- HighFreq::scrub_taq(ta_q=ta_q, win_dow=11, vol_mult=1)
```

season_ality *Perform seasonality aggregations over a single-column* xts *time series.*

Description

Perform seasonality aggregations over a single-column xts time series.

Usage

```
season_ality(x_ts, in_dex = format(index(x_ts), "%H:%M"))
```

Arguments

x_ts	single-column xts time series.
in_dex	vector of character strings representing points in time, of the same length as the argument x_ts.

Details

The function season_ality() calculates the mean of values observed at the same points in time specified by the argument in_dex. An example of a daily seasonality aggregation is the average price of a stock between 9:30AM and 10:00AM every day, over many days. The argument in_dex is passed into function tapply(), and must be the same length as the argument x_ts.

Value

An xts time series with mean aggregations over the seasonality interval.

Examples

```
# calculate running variance of each minutely OHLC bar of data
x_ts <- run_variance(SPY)
# remove overnight variance spikes at "09:31"
in_dex <- format(index(x_ts), "%H:%M")
x_ts <- x_ts[!in_dex=="09:31", ]
# calculate daily seasonality of variance
var_seasonal <- season_ality(x_ts=x_ts)
chart_Series(x=var_seasonal, name=paste(colnames(var_seasonal),
  "daily seasonality of variance"))
```

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