Package ‘bidask’

February 26, 2025

Type Package

Title Efficient Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices

Version 2.1.4

Description
Implements the efficient estimator of bid-ask spreads from open, high, low, and close prices described in Ardia, Guidotti, & Kroencke (JFE, 2024) <doi:10.1016/j.jfineco.2024.103916>. It also provides an implementation of the estimators described in Roll (JF, 1984) <doi:10.1111/j.1540-6261.1984.tb03897.x>, Corwin & Schultz (JF, 2012) <doi:10.1111/j.1540-6261.2012.01729.x>, and Abdi & Ranaldo (RFS, 2017) <doi:10.1093/rfs/hhx084>.

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URL `https://github.com/eguidotti/bidask`

BugReports `https://github.com/eguidotti/bidask/issues`

Encoding UTF-8

Imports data.table

RoxygenNote 7.2.3

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Config/testthat/edition 3

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edge *Efficient Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices*

Description

Implements the efficient estimator of bid-ask spreads from open, high, low, and close prices described in Ardia, Guidotti, & Kroencke (JFE, 2024): doi:10.1016/j.jfineco.2024.103916

Usage

```
edge(open, high, low, close, sign = FALSE)
```

Arguments

`open`	numeric vector of open prices.
`high`	numeric vector of high prices.
`low`	numeric vector of low prices.
`close`	numeric vector of close prices.
`sign`	whether to return signed estimates.

Details

Prices must be sorted in ascending order of the timestamp.

Value

The spread estimate. A value of 0.01 corresponds to a spread of 1%.

References

Ardia, D., Guidotti, E., Kroencke, T.A. (2024). Efficient Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices. Journal of Financial Economics, 161, 103916. doi:10.1016/j.jfineco.2024.103916

Examples

```
# reduce number of threads to pass CRAN checks (you can ignore this)
data.table::setDTthreads(1)

# simulate open, high, low, and close prices with spread 1%
x <- sim(n = 1000, spread = 0.01)

# estimate the spread
edge(x$Open, x$High, x$Low, x$Close)
```

`edge_expanding` *Expanding Estimates of Bid-Ask Spreads from Open, High, Low, and Close Prices*

Description

Implements an expanding window calculation of the efficient estimator of bid-ask spreads from open, high, low, and close prices described in Ardia, Guidotti, & Kroencke (JFE, 2024): doi:10.1016/j.jfineco.2024.103916.

Usage

```
edge_expanding(open, high, low, close, sign = FALSE, na.rm = TRUE)
```

Arguments

`open`	numeric vector of open prices.
`high`	numeric vector of high prices.
`low`	numeric vector of low prices.
`close`	numeric vector of close prices.
`sign`	whether to return signed estimates.
`na.rm`	whether to ignore missing values.

Details

Prices must be sorted in ascending order of the timestamp.

Value

Vector of spread estimates. A value of 0.01 corresponds to a spread of 1%. This function always returns a result of the same length as the input prices.

References

Ardia, D., Guidotti, E., Kroencke, T.A. (2024). Efficient Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices. Journal of Financial Economics, 161, 103916. doi:10.1016/j.jfineco.2024.103916

Examples

```
# reduce number of threads to pass CRAN checks (you can ignore this)
data.table::setDTthreads(1)

# simulate open, high, low, and close prices with spread 1%
x <- sim(n = 1000, spread = 0.01)

# estimate the spread using an expanding window
s <- edge_expanding(x$Open, x$High, x$Low, x$Close)
tail(s)
# equivalent to
s <- edge_rolling(x$Open, x$High, x$Low, x$Close, width = 1:nrow(x), na.rm = TRUE)
tail(s)
```

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edge_rolling *Rolling Estimates of Bid-Ask Spreads from Open, High, Low, and Close Prices*

Description

Implements a rolling window calculation of the efficient estimator of bid-ask spreads from open, high, low, and close prices described in Ardia, Guidotti, & Kroencke (JFE, 2024): doi:10.1016/j.jfineco.2024.103916.

Usage

```
edge_rolling(open, high, low, close, width, sign = FALSE, na.rm = FALSE)
```

Arguments

`open`	numeric vector of open prices.
`high`	numeric vector of high prices.
`low`	numeric vector of low prices.
`close`	numeric vector of close prices.
`width`	if an integer, the width of the rolling window. If a vector with the same length of the input prices, the width of the window corresponding to each observation. Otherwise, a vector of endpoints. See examples.
`sign`	whether to return signed estimates.
`na.rm`	whether to ignore missing values.

Details

Prices must be sorted in ascending order of the timestamp.

Value

Vector of spread estimates. A value of 0.01 corresponds to a spread of 1%. This function always returns a result of the same length as the input prices.

References

Ardia, D., Guidotti, E., Kroencke, T.A. (2024). Efficient Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices. Journal of Financial Economics, 161, 103916. doi:10.1016/j.jfineco.2024.103916

Examples

```
# reduce number of threads to pass CRAN checks (you can ignore this)
data.table::setDTthreads(1)

# simulate open, high, low, and close prices with spread 1%
x <- sim(n = 1000, spread = 0.01)

# estimate the spread using a rolling window
s <- edge_rolling(x$Open, x$High, x$Low, x$Close, width = 21)
tail(s)

# estimate the spread using custom endpoints
ep <- c(3, 35, 100)
s <- edge_rolling(x$Open, x$High, x$Low, x$Close, width = ep)
s[c(35, 100)]
# equivalent to
edge(x$Open[3:35], x$High[3:35], x$Low[3:35], x$Close[3:35])
edge(x$Open[35:100], x$High[35:100], x$Low[35:100], x$Close[35:100])

# estimate the spread using an expanding window
s <- edge_rolling(x$Open, x$High, x$Low, x$Close, width = 1:nrow(x))
tail(s)
# equivalent to
s <- edge_expanding(x$Open, x$High, x$Low, x$Close, na.rm = FALSE)
tail(s)
```

sim — *Simulation of Open, High, Low, and Close Prices*

Description

This function performs simulations consisting of `n` periods and where each period consists of a given number of `trades`. For each trade, the actual price P_t is simulated as $P_t = P_{t-1}e^{\sigma x}$, where σ is the standard deviation per trade and x is a random draw from a unit normal distribution. The standard deviation per trade equals the `volatility` divided by the square root of the number of `trades`. Trades are assumed to be observed with a given `probability`. The bid (ask) for each trade is defined as P_t multiplied by one minus (plus) half the `spread` and we assume a 50% chance that a bid (ask) is observed. High and low prices equal the highest and lowest prices observed during the period. Open and Close prices equal the first and the last price observed in the period. If no trade is observed for a period, then the previous Close is used as the Open, High, Low, and Close prices for that period.

Usage

```
sim(
  n = 10000,
  trades = 390,
  prob = 1,
  spread = 0.01,
  volatility = 0.03,
  overnight = 0,
  drift = 0,
  units = 1,
  sign = FALSE
)
```

Arguments

`n`	the number of periods to simulate.
`trades`	the number of trades per period.
`prob`	the probability to observe a trade.
`spread`	the bid-ask spread.
`volatility`	the open-to-close volatility.
`overnight`	the close-to-open volatility.
`drift`	the expected return per period.
`units`	the units of the time period. One of: `1`, `sec`, `min`, `hour`, `day`, `week`, `month`, `year`.
`sign`	whether to return positive prices for buys and negative prices for sells.

Value

A data.frame of open, high, low, and close prices if `units=1` (default). Otherwise, an `xts` object is returned (requires the `xts` package to be installed).

References

Ardia, D., Guidotti, E., Kroencke, T.A. (2024). Efficient Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices. Journal of Financial Economics, 161, 103916. doi:10.1016/j.jfineco.2024.103916

Examples

```
# reduce number of threads to pass CRAN checks (you can ignore this)
data.table::setDTthreads(1)
```

```
# simulate 10 open, high, low, and close prices with spread 1%
sim(n = 10, spread = 0.01)
```

spread — *Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices*

Description

This function implements several methods to estimate bid-ask spreads from open, high, low, and close prices and it is optimized for fast calculations over rolling and expanding windows.

Usage

```
spread(x, width = nrow(x), method = "EDGE", sign = FALSE, na.rm = FALSE)
```

Arguments

`x` tabular data with columns named `open`, `high`, `low`, `close` (case-insensitive).

`width` if an integer, the width of the rolling window. If a vector with the same length of the input prices, the width of the window corresponding to each observation. Otherwise, a vector of endpoints. By default, the full sample is used to compute a single spread estimate. See examples.

`method` the estimators to use. See details.

`sign` whether to return signed estimates.

`na.rm` whether to ignore missing values.

Details

The method `EDGE` implements the Efficient Discrete Generalized Estimator described in Ardia, Guidotti, & Kroencke (JFE, 2024).

The methods `OHL`, `OHLC`, `CHL`, `CHLO` implement the generalized estimators described in Ardia, Guidotti, & Kroencke (JFE, 2024). They can be combined by concatenating their identifiers, e.g., `OHLC.CHLO` uses an average of the `OHLC` and `CHLO` estimators.

The method `AR` implements the estimator described in Abdi & Ranaldo (RFS, 2017). `AR2` implements their 2-period version.

The method `CS` implements the estimator described in Corwin & Schultz (JF, 2012). `CS2` implements their 2-period version. Both versions are adjusted for overnight (close-to-open) returns as described in the paper.

The method `ROLL` implements the estimator described in Roll (JF, 1984).

Value

A data.frame of spread estimates, or an `xts` object if `x` is of class `xts`. A value of 0.01 corresponds to a spread of 1%.

References

Ardia, D., Guidotti, E., Kroencke, T.A. (2024). Efficient Estimation of Bid-Ask Spreads from Open, High, Low, and Close Prices. Journal of Financial Economics, 161, 103916. doi:10.1016/j.jfineco.2024.103916

Abdi, F., & Ranaldo, A. (2017). A simple estimation of bid-ask spreads from daily close, high, and low prices. Review of Financial Studies, 30 (12), 4437-4480. doi:10.1093/rfs/hhx084

Corwin, S. A., & Schultz, P. (2012). A simple way to estimate bid-ask spreads from daily high and low prices. Journal of Finance, 67 (2), 719-760. doi:10.1111/j.15406261.2012.01729.x

Roll, R. (1984). A simple implicit measure of the effective bid-ask spread in an efficient market. Journal of Finance, 39 (4), 1127-1139. doi:10.1111/j.15406261.1984.tb03897.x

Examples

```
# reduce number of threads to pass CRAN checks (you can ignore this)
data.table::setDTthreads(1)

# simulate open, high, low, and close prices with spread 1%
x <- sim(n = 1000, spread = 0.01)

# estimate the spread
spread(x)
# equivalent to
edge(x$Open, x$High, x$Low, x$Close)

# estimate the spread using a rolling window of 21 periods
s <- spread(x, width = 21)
tail(s)
# equivalent to
s <- edge_rolling(x$Open, x$High, x$Low, x$Close, width = 21)
tail(s)

# estimate the spread using an expanding window
s <- spread(x, width = 1:nrow(x))
tail(s)
# equivalent to
s <- edge_expanding(x$Open, x$High, x$Low, x$Close, na.rm = FALSE)
tail(s)

# estimate the spread using custom endpoints
ep <- c(3, 35, 100)
spread(x, width = ep)
# equivalent to
edge(x$Open[3:35], x$High[3:35], x$Low[3:35], x$Close[3:35])
edge(x$Open[35:100], x$High[35:100], x$Low[35:100], x$Close[35:100])

# use multiple estimators
spread(x, method = c(”EDGE”, ”AR”, ”CS”, ”ROLL”, ”OHLC”, ”OHL.CHL”))
```

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