Package 'cointmonitoR'

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Type Package

Title Consistent Monitoring of Stationarity and Cointegrating Relationships

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Description We propose a consistent monitoring procedure to detect a structural change from a cointegrating relationship to a spurious relationship. The procedure is based on residuals from modified least squares estimation, using either Fully Modified, Dynamic or Integrated Modified OLS. It is inspired by Chu et al. (1996) <DOI:10.2307/2171955> in that it is based on parameter estimation on a pre-break ``calibration" period only, rather than being based on sequential estimation over the full sample. See the discussion paper <DOI:10.2139/ssrn.2624657> for further information. This package provides the monitoring procedures for both the cointegration and the stationarity case (while the latter is just a special case of the former one) as well as printing and plotting methods for a clear presentation of the results.

URL https://github.com/aschersleben/cointmonitoR

BugReports https://github.com/aschersleben/cointmonitoR/issues

License GPL-3

Depends cointReg (>= 0.2.0)

Imports stats, graphics, matrixStats (>= 0.14.1)

RoxygenNote 5.0.1

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

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R topics documented:

`cointmonitoR-package` *The cointmonitoR package*

Description

Consistent Monitoring of Stationarity and Cointegrating Relationships

Details

See the vignette:
`vignette("cointmonitoR")`

See the DESCRIPTION:
`help(package = cointmonitoR)`

See the README:
https://github.com/aschersleben/cointmonitoR/blob/master/README.md

Open the package documentation page:
`package?cointmonitoR`

Further information and bug reporting:
https://github.com/aschersleben/cointmonitoR

Functions

- `monitorCointegration`
  This procedure is able to monitor a cointegration model for level or trend cointegration and returns the corresponding break point, if available. It is based on parameter estimation on a pre-break "calibration" period at the beginning of the sample that is known or assumed to be free of structural change.
- `monitorStationarity`
  This procedure is a special case of `monitorCointegration`, since it's able to monitor a one-dimensional vector for level or trend stationarity.
- `print`
  Print clear results.
- `plot`
  Plot the test statitics and the values/residuals of a `cointmonitoR` model.

Dependencies

This package mainly depends on our cointReg package.

`monitorCointegration` *Procedure for Monitoring Level and Trend Cointegration*

Description

This procedure is able to monitor a cointegration model for level or trend cointegration and returns the corresponding break point, if available. It is based on parameter estimation on a pre-break "calibration" period at the beginning of the sample that is known or assumed to be free of structural change and can be specified exactly via the `m` argument (see Details for further information).

Usage

```
monitorCointegration(x, y, m = 0.25, model = c("FM", "D", "IM"),
  trend = FALSE, kernel = c("ba", "pa", "qs", "tr"), bandwidth = c("and",
  "nw"), D.options = NULL, signif.level = 0.05, return.stats = TRUE,
  return.input = TRUE, check = TRUE, ...)
```

Arguments

`x`	[`numeric	matrix	data.frame`] Data on which to apply the monitoring procedure (RHS).
`y`	[`numeric	matrix	data.frame`] Data on which to apply the monitoring procedure (LHS). Has to be one-dimensional. If `matrix`, it may have only one row or column, if `data.frame` just one column.
`m`	[`numeric(1)`] Length of calibration period as fraction of the data's length (between 0.1 and 0.9) or as number of observations (see Details).
`model`	[`character(1)`] The model to be used for modified OLS calculations. Should be one of FM-OLS (`"FM"`), D-OLS (`"D"`) or IM-OLS (`"IM"`).
`trend`	[`logical`] Should an intercept and a linear trend be included? If `FALSE` (default), only an intercept is included.
`kernel`	[`character(1)`] The kernel function to use for calculating the long-run variance. Default is Bartlett kernel (`"ba"`), see Details for alternatives.
`bandwidth`	[`character(1)	numeric(1)`] The bandwidth to use for calculating the long-run variance. Default is Andrews (1991) (`"and"`), an alternative is Newey West (1994) (`"nw"`). You can also set the bandwidth manually.

`D.options` [list | NULL]
Options for the D-OLS calculations. A list with elements `n.lead`, `n.lag`, `kmax` and `info.crit` – or NULL (then default arguments are the same as in `cointRegD`. See that help page for further information.) Missing list elements will be replaced automatically.

`signif.level` [numeric(1)]
Level of significance (between 0.01 and 0.1). Detection time will be calculated only if the estimated p-value is smaller than `signif.level`. Default is 0.05.

`return.stats` [logical]
Whether to return all test statistics. Default is TRUE.

`return.input` [logical]
Whether to return the input data, default is TRUE.

`check` [logical]
Wheather to check (and if necessary convert) the arguments. See `checkVars` for further information.

`...` Arguments passed to `getBandwidthNW` (`inter`, `weights`), if `bandwidth = "nw"`.

Details

The calibration period can be set by setting the argument `m` to the number of the last observation, that should be inside this period. The corresponding fraction of the data's length will be calculated automatically. Alternatively you can set `m` directly to the fitting fraction value, but you should pay attention to the fact, that the calibration period may become smaller than intended: The last observation is calculated as `floor(m * N)` (with `N` the length of `x`).

The kernel that is used for calculating the long-run variance can be one of the following:

- `"ba"`: Bartlett kernel
- `"pa"`: Parzen kernel
- `"qs"`: Quadratic Spectral kernel
- `"tr"`: Truncated kernel

Value

`cointmonitoR` object with components:

`Hsm` [`numeric(1)`] value of the test statistic

`time` [`numeric(1)`] detected time of structural break

`p.value` [`numeric(1)`] estimated p-value of the test (between 0.01 and 0.1)

`cv` [`numeric(1)`] critical value of the test

`sig` [`numeric(1)`] significance level used for the test

`residuals` [`numeric`] residuals of the modified OLS model to be used for calculating the test statistics

`model` [`character(1)`] `cointOLS` model ("FM", "D", or "IM")

`trend` [`character(1)`] trend model ("level" or "trend")

`name` [`character(1)`] name(s) of data

`m` [`list(2)`] list with components:
`$m.frac` [`numeric(1)`]: calibration period (fraction)
`$m.index` [`numeric(1)`]: calibration period (length)

`kernel` [`character(1)`] kernel function

`bandwidth` [`list(2)`] `$name` [`character(1)`]: bandwidth function (name)
`$number` [`numeric(1)`]: bandwidth

`statistics` [`numeric`] values of test statistics with the same length as data, but `NA` during calibration period (available if `return.stats = TRUE`)

`input` [`numeric` | `matrix` | `data.frame`] copy of input data (available if `return.stats = TRUE`)

`D.options` [`list`] information about further parameters (available if `model = "D"`)

References

- Wagner, M. and D. Wied (2015): "Monitoring Stationarity and Cointegration," *Discussion Paper*, DOI:10.2139/ssrn.2624657.

See Also

Other cointmonitoR: `monitorStationarity`, `plot.cointmonitoR`, `print.cointmonitoR`

Examples

```
set.seed(42)
x = data.frame(x1 = cumsum(rnorm(200)), x2 = cumsum(rnorm(200)))
eps1 = rnorm(200, sd = 2)
eps2 = c(eps1[1:100], cumsum(eps1[101:200]))

y = x$x1 - x$x2 + 10 + eps1
monitorCointegration(x = x, y = y, m = 0.5, model = "FM")

y2 = y + seq(1, 30, length = 200)
monitorCointegration(x = x, y = y2, m = 0.5, model = "FM")
monitorCointegration(x = x, y = y2, m = 0.5, trend = TRUE, model = "FM")

y3 = x$x1 - x$x2 + 10 + eps2
monitorCointegration(x = x, y = y3, m = 0.5, model = "FM")
monitorCointegration(x = x, y = y3, m = 0.5, model = "D")
monitorCointegration(x = x, y = y3, m = 0.5, model = "IM")
```

`monitorStationarity` *Procedure for Monitoring Level and Trend Stationarity*

Description

This procedure is able to monitor a one-dimensional vector for level or trend stationarity and returns the corresponding break point, if available. It is based on parameter estimation on a pre-break "calibration" period at the beginning of the sample that is known or assumed to be free of structural change and can be specified exactly via the `m` argument (see Details for further information).

Usage

```
monitorStationarity(x, m = 0.25, trend = FALSE, kernel = c("ba", "pa",
  "qs", "tr"), bandwidth = c("and", "nw"), signif.level = 0.05,
  return.stats = TRUE, return.input = TRUE, check = TRUE, ...)
```

Arguments

`x`	[`numeric`	`matrix`	`data.frame`] Data on which to apply the monitoring procedure. If `matrix`, it may have only one row or column, if `data.frame` just one column.
`m`	[`numeric(1)`] Length of calibration period as fraction of the data's length (between 0.1 and 0.9) or as number of observations (see Details).
`trend`	[`logical`] Should an intercept and a linear trend be included? If `FALSE` (default), only an intercept is included.
`kernel`	[`character(1)`] The kernel function to use for calculating the long-run variance. Default is Bartlett kernel (`"ba"`), see Details for alternatives.
`bandwidth`	[`character(1)`	`numeric(1)`] The bandwidth to use for calculating the long-run variance. Default is Andrews (1991) (`"and"`), an alternative is Newey West (1994) (`"nw"`). You can also set the bandwidth manually.
`signif.level`	[`numeric(1)`] Level of significance (between 0.01 and 0.1). Detection time will be calculated only if the estimated p-value is smaller than `signif.level`. Default is 0.05.
`return.stats`	[`logical`] Whether to return all test statistics. Default is `TRUE`.
`return.input`	[`logical`] Whether to return the input data, default is `TRUE`.
`check`	[`logical`] Wheather to check (and if necessary convert) the arguments. See `checkVars` for further information.
`...`	Arguments passed to `getBandwidthNW` (`inter`, `weights`), if `bandwidth = "nw"`.

Details

The calibration period can be specified by setting the argument `m` to the number of its last observation. The corresponding fraction of the data's length will be calculated automatically. Alternatively

you can set `m` directly to the fitting fraction value. Attention: The calibration period may become smaller than intended: The last observation is calculated as `floor(m * N)` (with `N` = length of `x`).

The kernel that is used for calculating the long-run variance can be one of the following:

- `"ba"`: Bartlett kernel
- `"pa"`: Parzen kernel
- `"qs"`: Quadratic Spectral kernel
- `"tr"`: Truncated kernel

Value

`cointmonitoR` object with components:

`Hsm` [`numeric(1)`] value of the test statistic

`time` [`numeric(1)`] detected time of structural break

`p.value` [`numeric(1)`] estimated p-value of the test (between 0.01 and 0.1)

`cv` [`numeric(1)`] critical value of the test

`sig` [`numeric(1)`] significance level used for the test

`trend` [`character(1)`] trend model ("level" or "trend")

`name` [`character(1)`] name(s) of data

`m` [`list(2)`] list with components:
`$m.frac` [`numeric(1)`]: calibration period (fraction)
`$m.index` [`numeric(1)`]: calibration period (length)

`kernel` [`character(1)`] kernel function

`bandwidth` [`list(2)`] `$name` [`character(1)`]: bandwidth function (name)
`$number` [`numeric(1)`]: bandwidth

`statistics` [`numeric`] values of test statistics with the same length as data, but `NA` during calibration period (available if `return.stats = TRUE`)

`input` [`numeric` | `matrix` | `data.frame`] copy of input data (available if `return.stats = TRUE`)

References

- Wagner, M. and D. Wied (2015): "Monitoring Stationarity and Cointegration," *Discussion Paper*, DOI:10.2139/ssrn.2624657.

See Also

Other cointmonitoR: `monitorCointegration`, `plot.cointmonitoR`, `print.cointmonitoR`

Examples

```
set.seed(1909)
x <- rnorm(200)
x2 <- c(x[1:100], cumsum(x[101:200]) / 2)

# Specify the calibration period
# as fraction of the total length of x:
monitorStationarity(x, m = 0.25)
monitorStationarity(x2, m = 0.465)

# Specify the calibration period
# by setting its last observation exactly:
monitorStationarity(x, m = 50)
monitorStationarity(x2, m = 93)
```

`plot.cointmonitoR` *Plot Method for Monitoring Procedures.*

Description

Plotting objects of class `"cointmonitoR"`.

Usage

```
## S3 method for class 'cointmonitoR'
plot(x, what = "test", type, main, xlab, ylab,
  axes = TRUE, legend = TRUE, main.val, xlab.val, ylab.val, lines = TRUE,
  ...)
```

Arguments

`x`	[`cointmonitoR`] Object of class `"cointmonitoR"`, i.e. the result of `monitorStationarity` or `monitorCointegration`.
`what`	[`character`] Whether to plot test statistics (`"test"`) (default) or the values/residuals of the tested time series (`"values"` or `"residuals"`) or `"both"`. Works only, if `return.stats = TRUE` in the called function that to get `x` (default setting).
`type`	[`character`] Plot type (from `plot`). Default is `"l"`.
`main, xlab, ylab`	[`character`] Title and axis titles (from `plot`). Default values will be generated from the contents of `x`.
`axes, legend`	[`logical`] Whether to add axes (from `plot`) and a legend to the plot.

`main.val, xlab.val, ylab.val`
: [character]
Title and axis titles (from `plot`) for the second plot, if generating both plots in one step (see argument `what`). Default values will be generated from the contents of `x`.

`lines`
: [logical]
Whether to add lines and annotations to the plot. Default is `TRUE`.

`...`
: [any]
Further arguments passed to `plot`.

See Also

Other cointmonitoR: `monitorCointegration`, `monitorStationarity`, `print.cointmonitoR`

Examples

```
### Monitoring stationarity (no break):
set.seed(1909)
x = rnorm(200)
test = monitorStationarity(x, m = 0.5)
plot(test)

oldpar = par(mfrow = c(2, 1), mar = c(4, 4, 1, 1))
plot(test, what = "both", legend = FALSE, main = "", main.val = "")
par(oldpar)


### Monitoring stationarity (break):
x = c(x[1:100], cumsum(rnorm(100, sd = 0.5)) + x[101:200])
test2 = monitorStationarity(x, m = 0.5)
plot(test2)

oldpar = par(mfrow = c(2, 1), mar = c(4, 4, 1, 1))
plot(test2, what = "both", legend = FALSE, main = "", main.val = "")
par(oldpar)


### Monitoring cointegration (no break):
set.seed(42)
x = data.frame(x1 = cumsum(rnorm(200)), x2 = cumsum(rnorm(200)))
eps1 = rnorm(200, sd = 2)
y = x$x1 - x$x2 + 10 + eps1
test3 = monitorCointegration(x = x, y = y, m = 0.5, model = "FM")
plot(test3)

oldpar = par(mfrow = c(2, 1), mar = c(4, 4, 1, 1))
plot(test3, what = "both", legend = FALSE, main = "", main.val = "")
par(oldpar)


### Monitoring cointegration (break):
eps2 = c(eps1[1:100], cumsum(eps1[101:200]))
```

```
y = x$x1 - x$x2 + 10 + eps2
test4 = monitorCointegration(x = x, y = y, m = 0.5, model = "FM")
plot(test4)

oldpar = par(mfrow = c(2, 1), mar = c(4, 4, 1, 1))
plot(test4, what = "both", legend = FALSE, main = "", main.val = "")
par(oldpar)
```

`print.cointmonitoR` *Print Method for Monitoring Procedures.*

Description

Printing objects of class "cointmonitoR".

Usage

```
## S3 method for class 'cointmonitoR'
print(x, ..., digits = getOption("digits"))
```

Arguments

x	[cointmonitoR] Object of class "cointmonitoR", i.e. the result of monitorStationarity() or monitorCointegration().
...	ignored
digits	[numeric] Number of significant digits to be used.

Value

The invisible x object.

See Also

Other cointmonitoR: monitorCointegration, monitorStationarity, plot.cointmonitoR

Examples

```
set.seed(42)
test = monitorStationarity(rnorm(100), m = 0.5)
print(test)

x = data.frame(x1 = cumsum(rnorm(200)), x2 = cumsum(rnorm(200)))
eps1 = rnorm(200, sd = 2)
eps2 = c(eps1[1:100], cumsum(eps1[101:200]))
y1 = x$x1 - x$x2 + 10 + eps1
```

```
y2 = x$x1 - x$x2 + 10 + eps2
test1 = monitorCointegration(x = x, y = y1, m = 0.5, model = "FM")
print(test1)
test2 = monitorCointegration(x = x, y = y2, m = 0.5, model = "FM")
print(test2)
```

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