Package: synthReturn (via r-universe)

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Type Package

Title Synthetic Matching Method for Returns

Version 1.0.1

Description Implements the revised Synthetic Matching Algorithm of Kreitmeir, Lane, and Raschky (2025) <doi:10.2139/ssrn.3751162>, building on the original approach of Acemoglu, Johnson, Kermani, Kwak, and Mitton (2016) <doi:10.1016/j.jfineco.2015.10.001>, to estimate the cumulative treatment effect of an event on treated firms' stock returns.

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URL https://github.com/davidkreitmeir/synthReturn

BugReports https://github.com/davidkreitmeir/synthReturn/issues

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Imports base (>= 4.0.0), stats, utils, corpcor (>= 1.6.10), data.table, quadprog (>= 1.5), parallel, mirai

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`ret_two_evdates` *Simulated timeseries of stock returns*

Description

`ret_two_evdates` presents a simulated timeseries of stock returns for 20 treated firms and a set of 60 potential control firms. The simulated data allows for a max estimation window of 100 trading days (in event time: -100 to -1) and a max event window of 6 trading days (in event time: 0 to +5).

Usage

```
ret_two_evdates
```

Format

`ret_two_evdates` has 14,000 rows and 5 variables:

eventdate Calendar date when the event happened (`<Date>`).

date Calendar date (`<Date>`).

ret Raw stock return (`<num>`).

treat Binary treatment indicator (`<lgcl>`).

unit Unique identifier for each treated, respectively control firm (`<int>`).

`ret_two_evdates_num` *Simulated timeseries of stock returns*

Description

`ret_two_evdates_num` presents a simulated timeseries of stock returns for 20 treated firms and a set of 60 potential control firms. The simulated data allows for a max estimation window of 100 trading days (in event time: -100 to -1) and a max event window of 6 trading days (in event time: 0 to +5).

Usage

```
ret_two_evdates_num
```

Format

`ret_two_evdates_num` has 14,000 rows and 5 variables:

eventdate Numeric date when the event happened (`<int>`).

date Numeric date (`<int>`).

ret Raw stock return (`<num>`).

treat Binary treatment indicator (`<lgcl>`).

unit Unique identifier for each treated, respectively control firm (`<int>`).

`synthReturn` *Compute synthetic returns*

Description

`synthReturn` implements the revised *Synthetic Matching Algorithm* of Kreitmeir et al. (2025), building on the original approach of Acemoglu et al. (2016), to estimate the *cumulative treatment effect* of an event on treated firms' stock returns.

Usage

```
synthReturn(
  data,
  unitname,
  treatname,
  dname,
  rname,
  edname,
  estwind,
  eventwind,
  estobs_min = 1,
  eventobs_min = 1,
  inference = c("none", "permutation", "bootstrap"),
  correction = FALSE,
  ncontrol_min = 10,
  ndraws = 25,
  ncores = NULL,
  static_scheduling = TRUE
)
```

Arguments

`data`	The name of the data frame that contains the data.
`unitname`	The name of the column containing IDs of treated and control units.
`treatname`	The name of the indicator column set to `TRUE` for the treatment group and to `FALSE` for the control group. The column's values must be time-constant within a unit because they mark whether a unit was ever treated.

dname	The name of the column containing the date variable. The column must either be of type Date or numeric. See details.
rname	The name of the column containing the stock returns.
edname	The name of the column containing the (treatment unit-specific) event date. All event dates must also exist in dname. The column must either be of type Date or numeric. Event date values are ignored for control group units. See details.
estwind	Argument to set estimation window period in relative time to event, i.e. c(estwind_start, estwind_end). 0 is the event date. The interval only considers observed time periods. See details.
eventwind	Argument to set event window period in relative time to event, i.e. c(eventwind_start, eventwind_end). 0 is the event date. The interval only considers observed time periods. See details.
estobs_min	Argument to define minimum number of trading days during the estimation window. Can be an integer or a proportion (i.e. between 0 and 1). Default is 1, i.e. no missing trading days are allowed.
eventobs_min	Argument to define minimum number of trading days during the event window. Can be an integer or a proportion (i.e. between 0 and 1). Default is 1, i.e. no missing trading days are allowed.
inference	Argument to define which inference method is to be used. Both permutation and bootstrap inference are implemented. Default is "none".
correction	Logical defining if "corrected" synthetic matching results are used for inference. If TRUE firms that do not have a good synthetic match, defined as firms in the control group with σ more than $\sqrt{3}$ times the average σ of the treated firms, are excluded. Default is FALSE. correction has no effect if inference = "none".
ncontrol_min	Minimum number of control firms required to create synthetic match. Default is 10.
ndraws	Number of randomly drawn placebo treatment groups if inference = "permutation". Number of nonparametric bootstrap repetitions if inference = "bootstrap". Has to be larger than 1. ndraws has no effect if inference = "none".
ncores	Number of CPU cores to use. NULL (the default) sets it to the number of available cores.
static_scheduling	Logical setting the parallel scheduling type. TRUE (default) implies static scheduling, FALSE dynamic scheduling. This parameter does not change the output object. It only influences the speed of the function. The scheduling choice has no effect when ncores = 1 and in inference = "permutation" estimations on Windows machines.

Details

The data's dname and edname columns refer to dates. dname is the date that a row refers to. edname is the date when a unit was treated. I.e., edname is constant across all rows per unit. And it is ignored for never treated units.

The package does not care what interval a time period refers to. It evaluates units' sequences of distinct Date or numerical values in dname and edname, irrespective of whether they denote days, hours, etc.

estwind and eventwind describe sections in these sequences. 0 is the treatment time. Hence, c(-1, -100) is a unit's 100 observations before treatment. When dname and edname are in days and a specific unit is observed on 2 days per week, c(-1, -100) covers 50 weeks before treatment in the case of that unit. In the case of financial data, that would be a company's 100 trading days before treatment.

Value

An S3 object containing the following components:

n_treat_pre	Number of treatment units in the data.
n_treat_res	Number of treatment units in the data that fulfill the minimum requirements and are used in the calculation of the average treatment effect ϕ.
ate	Data.table containing the relative time period τ and the average treatment effect estimates ϕ. If the user selects inference = "permutation", the data.table additionally reports the p-value and the 95 percent confidence interval. If the user selects inference = "bootstrap", the data.table additionally reports the standard error, the p-value and the 95 percent confidence interval.
ar	Data.table reporting the estimated abnormal returns, the "goodness" of the synthetic match estimate σ, the weighted cumulative abnormal return and the corresponding weights for all treated firms.
ate_bootstrap	Data.table containing the average treatment effect estimates ϕ for each bootstrap iteration. Returned if the user chooses inference = "bootstrap".
n_bootstrap	Number of bootstrap iterations that returned a valid result.
ate_placebo	Data.table containing the average treatment effect estimates ϕ for each placebo treatment group draw. Returned if the user chooses inference = "permutation".
n_placebo	Number of placebo draws that returned a valid result.
call	List with arguments used in the call.

Examples

```
# Load data in that comes in the synthReturn package
data(ret_two_evdates)

# ------------------------------------------------
# Example with Permutation Inference
# ------------------------------------------------

set.seed(123) # set random seed

# Run synthReturn
res.placebo <- synthReturn(
  data = ret_two_evdates,
  unitname = "unit",
  treatname = "treat",
  dname = "date",
  rname = "ret",
  edname = "eventdate",
```

```
  estwind = c(-100,-1),
  eventwind = c(0,5),
  estobs_min = 1,
  eventobs_min = 1,
  inference = "permutation",
  correction = FALSE,
  ncontrol_min = 10,
  ndraws = 10,
  ncores = 1
  )

# ------------------------------------------------
# Example with Nonparametric Bootstrap
# ------------------------------------------------

set.seed(123) # set random seed

# Run synthReturn
res.boot <- synthReturn(
  data = ret_two_evdates,
  unitname = "unit",
  treatname = "treat",
  dname = "date",
  rname = "ret",
  edname = "eventdate",
  estwind = c(-100,-1),
  eventwind = c(0,5),
  estobs_min = 1,
  eventobs_min = 1,
  inference = "bootstrap",
  correction = FALSE,
  ncontrol_min = 10,
  ndraws = 25,
  ncores = 1
)

# ------------------------------------------------
# Example with Missing Returns
# ------------------------------------------------

set.seed(123) # set random seed
# Randomly introduce 2% of missing return values
ret_two_evdates[sample.int(nrow(ret_two_evdates), floor(0.02*nrow(ret_two_evdates))), ret := NA]
# Run synthReturn
res.boot <- synthReturn(
  data = ret_two_evdates,
  unitname = "unit",
  treatname = "treat",
  dname = "date",
  rname = "ret",
  edname = "eventdate",
  estwind = c(-100,-1),
  eventwind = c(0,5),
```

```
  estobs_min = 0.9, # require 90% of trading days during estimation window w/ non-missing returns
  eventobs_min = 0.9, # require 90% of trading days during event window w/ non-missing returns
   inference = "bootstrap",
   correction = FALSE,
   ncontrol_min = 10,
   ndraws = 25,
   ncores = 1
)
```

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