Package 'fHMM'

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Type Package

Title Fitting Hidden Markov Models to Financial Data

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Description Fitting (hierarchical) hidden Markov models
to daily share prices provided by <https://finance.yahoo.com/>.
See <https://github.com/loelschlaeger/fHMM#readme> for documentation and examples.

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Encoding UTF-8

Imports MASS, progress, Rcpp, tseries

LinkingTo Rcpp, RcppArmadillo

Depends R (>= 3.5.0)

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Suggests rmarkdown, knitr

VignetteBuilder knitr

NeedsCompilation yes

Author Lennart Oelschläger [aut, cre],
Timo Adam [aut],
Michels Rouven [aut]

Maintainer Lennart Oelschläger <lennart.oelschlaeger@uni-bielefeld.de>

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R topics documented:

`apply_viterbi` *Viterbi algorithm*

Description

Applies the Viterbi algorithm (https://en.wikipedia.org/wiki/Viterbi_algorithm) for state decoding.

Usage

```
apply_viterbi(data, fit, controls)
```

Arguments

`data`	A list of processed data information.
`fit`	A list of fitted model information.
`controls`	A list of controls.

Value

A vector (in case of a HMM) or a matrix (in case of a hierarchical HMM) of decoded states.

check_controls *Check controls*

Description

This function checks the specification of `controls`.

Usage

```
check_controls(controls)
```

Arguments

`controls`	A list of controls.

Details

See the vignettes on how to specify `controls`.

Value

Checked version of `controls`.

check_decoding *Decoding check*

Description

Summarizes and saves decoded states.

Usage

```
check_decoding(decoding, data, controls)
```

Arguments

`decoding`	A vector (in case of a hmm) or a matrix (in case of a hierarchical HMM) of decoded states.
`data`	A list of processed data information.
`controls`	A list of controls.

Value

No return value. Creates output file "states.txt".

check_estimation *Estimation check*

Description

Summarizes and saves estimates.

Usage

```
check_estimation(mods, lls, data, hessian, controls)
```

Arguments

mods	A list of fitted models in the different estimation runs.
lls	A vector of log-likelihood values of accepted mods.
data	A list of processed data information.
hessian	Hessian matrix of the estimated model.
controls	A list of controls.

Value

A list of fitted model information.

check_saving *Saving check*

Description

This function saves model results while checking for overwriting.

Usage

```
check_saving(object = NULL, name = NULL, filetype, controls)
```

Arguments

object	An object to be saved.
name	A character, the name of the object to be saved.
filetype	A character, the filetype of the object to be saved.
controls	A list of controls.

Value

A boolean, determining whether saving is possible or not. If filetype="rds", object is saved.

compute_ci *Confidence intervals*

Description

Computes confidence intervals for the estimates.

Usage

```
compute_ci(fit, controls)
```

Arguments

fit	A list of fitted model information.
controls	A list of controls.

Value

A list containing the following elements:

lb_ci_level	lower bound of the intervals
estimate	estimates
ub_ci_level	upper bound of the intervals

where ci_level is set in controls.

compute_fs *Fine-scale chunk lengths*

Description

Computes (flexible) fine-scale chunk lengths.

Usage

```
compute_fs(fs_time_horizon, T = NA, fs_dates = NA)
```

Arguments

fs_time_horizon	Either a numeric or one of "w", "m", "q", "y", setting the fine-scale dimension.
T	A numeric, the dimension of the coarse-scale process, default NA.
fs_dates	A vector of dates of empirical fine-scale observations, default NA.

Value

A vector of fine-scale chunk sizes.

create_visuals *Visualization*

Description

Calls functions for visualization of model results.

Usage

```
create_visuals(data, fit, decoding, controls, events)
```

Arguments

data	A list of processed data information.
fit	A list of fitted model information.
decoding	A vector (in case of a HMM) or a matrix (in case of a hierarchical HMM) of decoded states.
controls	A list of controls.
events	A list of (historical, financial) events.

Value

No return value. Calls visualization functions `plot_sdd`, `plot_ts` and `pseudo_residuals`.

download_data *Data download*

Description

Download financial data from https://finance.yahoo.com.

Usage

```
download_data(
  name = NA,
  symbol = NA,
  from = "1902-01-01",
  to = Sys.Date(),
  show_symbols = FALSE,
  path
)
```

Arguments

name	A character, personal identifier for a stock, default NA.
symbol	A character, the stock's symbol, default NA.
from	A date, setting the lower data bound, default is "1902-01-01".
to	A date, setting the upper data bound, default is the current date Sys.date().
show_symbols	A boolean, determining whether all saved symbols should be printed, default FALSE.
path	A character, setting the data saving path.

Details

symbol has to match the official symbol on https://finance.yahoo.com. Once used stock symbols are saved in "stock_symbols.rds" in the folder "path/data". Values for from earlier than its default value are set to the default value.

Value

No return value. Downloaded data is saved as "name.csv" in the folder "path/data".

Examples

```
### download 21st century DAX data
download_data(name="dax",symbol="^GDAXI",from=as.Date("2000-01-03"),path=tempdir())
```

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exception *Debugging*

Description

Provides suggestions for debugging for a given exception code.

Usage

```
exception(code)
```

Arguments

code	A character, the exception code.

Value

A list containing the following elements:

code	exception code
response	message
debugging	suggestions for debugging

Examples

```
exception("S.1")
```

`fit_hmm` *Fit (hierarchical) hidden Markov models to financial data*

Description

Performs data processing, fitting, state decoding and visualization.

Usage

```
fit_hmm(controls, events, sim_par)
```

Arguments

`controls`	A list of controls (optional).
`events`	A list of (historical, financial) events (optional).
`sim_par`	A list of model parameters for simulation in `thetaList` format, default `NULL` (optional).

Details

Specify a model by setting parameters of the named list `controls` and passing it to `fit_hmm`. See the vignettes on how to specify `controls`.

Value

No return value. Estimation results are saved in "`controls[["path"]]`/models/`controls[["id"]]`".

Examples

```
### fitting a 2-state HMM with state-dependent t-distributions to simulated data
controls = list(
  path    = tempdir(),
  id      = "test",
  model   = "hmm",
  states  = 2,
  sdds    = "t",
  horizon = 200,
  fit     = list("runs" = 10, "seed" = 1)
)
fit_hmm(controls)
```

init_est *Initialisation*

Description

Samples initial parameter values for the estimation routine.

Usage

```
init_est(controls)
```

Arguments

controls	A list of controls.

Value

A vector of parameters values in format thetaUncon.

max_likelihood *Optimization*

Description

Maximizes the model's log-likelihood function.

Usage

```
max_likelihood(data, controls)
```

Arguments

data	A list of processed data information.
controls	A list of controls.

Details

Uses nlm for numerical optimization.

Value

A list of fitted model information.

parameter_names *Parameter names*

Description

Creates model parameter names.

Usage

```
parameter_names(controls, all)
```

Arguments

controls	A list of controls.
all	A boolean, determining whether all (all=TRUE) or only estimated (all=FALSe) names should be produced.

Value

Vector of model parameter names.

plot_ll *Visualization of log-likelihood values*

Description

Plots log-likelihood values of the different estimation runs.

Usage

```
plot_ll(lls, controls)
```

Arguments

lls	A vector of log-likelihood values.
controls	A list of controls.

Value

No return value. Creates file "log_likelihoods.pdf" in "controls[["path"]]/models/controls[["id"]]".

plot_sdd *Visualization of estimated state-dependent distributions*

Description

Plots the estimated state-dependent distributions.

Usage

```
plot_sdd(controls, data, fit, decoding, colors)
```

Arguments

controls	A list of controls.
data	A list of processed data information.
fit	A list of fitted model information.
decoding	A vector (in case of a HMM) or a matrix (in case of a hierarchical HMM) of decoded states.
colors	A matrix of colors for different states.

Value

No return value. Creates file "state_dependent_distributions.pdf" in "controls[["path"]]/models/controls[["id"]]".

plot_ts *Visualize decoded time-series*

Description

Visualize decoded time-series

Usage

```
plot_ts(controls, data, decoding, colors, events)
```

Arguments

controls	A list of controls.
data	A list of processed data information.
decoding	A matrix of decoded states.
colors	A matrix of colors for different states.
events	A list of events.

Value

No return value, creates graphic in controls[["path"]]/models/controls[["id"]]

process_data *Data processing*

Description

Calls functions for processing or simulating data.

Usage

```
process_data(controls, sim_par)
```

Arguments

controls	A list of controls.
sim_par	A vector of model parameters for simulation.

Value

A list of processed data information and on-screen information.

pseudo_residuals *Pseudo-residuals*

Description

Computes and visualizes pseudo-residuals.

Usage

```
pseudo_residuals(controls, data, fit, decoding)
```

Arguments

controls	A list of controls.
data	A list of processed data information.
fit	A list of fitted model information.
decoding	A vector (in case of a HMM) or a matrix (in case of a hierarchical HMM) of decoded states.

Value

No return value. Creates files "pseudo_residuals.pdf" and "pseudos.rds" in "controls[["path"]]/models/controls[["id"]

read_data *Read .csv-file*

Description

Reads financial data from .csv-file.

Usage

```
read_data(controls)
```

Arguments

controls	A list of controls.

Value

A list containing the following elements:

data	A matrix of data that is modeled.
data_raw	A matrix of raw data.
data_fs_raw	A matrix of raw fine-scale data.
data_cs_raw	A matrix of raw coarse-scale data.
dates	A vector of dates.
T_star	A vector of fine-scale chunk sizes.

simulate_data *Data simulation*

Description

Simulates data from a (hierarchical) hidden Markov model.

Usage

```
simulate_data(controls, sim_par)
```

Arguments

controls	A list of controls.
sim_par	A list of model parameters for simulation in thetaList format.

Value

A list containing the following elements:

`data`	A matrix of simulated data.
`states0`	A matrix of simulated hidden states.
`thetaUncon0`	True parameters in format `thetaUncon`.
`thetaCon0`	True parameters in format `thetaCon`.
`thetaList0`	True parameters in format `thetaList`.
`T_star`	A vector of fine-scale chunk sizes.

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