Package 'RGN'

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Type Package

Title Robust-Gauss Newton (RGN) Optimization of Sum-of-Squares Objective Function

Version 1.0.0

Description Implementation of the Robust Gauss-Newton (RGN) algorithm, designed for solving optimization problems with a sum of least squares objective function. For algorithm details please refer to Qin et. al. (2018) <doi:10.1029/2017WR022488>.

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URL https://github.com/ClimateAnalytics/RGN/

BugReports https://github.com/ClimateAnalytics/RGN/issues

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Suggests testthat (>= 3.0.0)

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`BassRiverData` *Hydrological data for Bass River catchment in Victoria, Australia*

Description

Streamflow, rainfall and PET data for Bass River catchment (227219) in Victoria, Australia. Originally obtained from Francis Chiew.

Usage

```
data(BassRiver)
```

Format

List containing numerical vectors for precipitation (`Rain.mm`), potential evapotranspiration (`ET.mm`), and runoff (`Runoff.mm.day`), and date vector (`Date`)

References

https://github.com/eachonly/Robust-Gauss-Newton-Algorithm, http://www.bom.gov.au/water/hrs/

`rgn` *Robust Gauss Newton optimization*

Description

`rgn` performs optimization of weighted-sum-of-squares (WSS) objective function using the Robust Gauss Newton algorithm

Usage

```
rgn(
  simFunc,
  simTarget = 0,
  weights = NULL,
  par,
  lower,
  upper,
  control = NULL,
  ...
)
```

Arguments

simFunc	is a function that simulates a (vector) response, with first argument the vector of parameters over which optimization is performed
simTarget	is the target vector that simFunc is trying to match
weights	is a vector of weights used in the WSS objective function. Defaults to equal weights.
par	is the vector of initial parameters
lower	is the lower bounds on parameters
upper	is the upper bounds on parameters
control	list of RGN settings • control$n.multi is number of multi-starts (i.e. invocations of optimization with different initial parameter estimates). Default is 1. • control$iterMax is maximum iterations. Default is 100. • control$dump is level of diagnostic outputs between 0 (none) and 3 (highest). Default is 0. • control$keep.multi (TRUE/FALSE) controls whether diagnostic output from each multi-start is recorded. Default is FALSE. • control$logFile is log file name
...	other arguments to simFunc()

Details

rgn minimizes the objective function sum((weights*(simFunc-simTarget)^2)), which is a sum of squared weighted residuals (residuals=weights*(simFunc-simTarget)). Note simFunc corresponds to the vector of residuals when default arguments for simTarget and weights are used.

Value

List with

- par, the optimal parameters
- value, the optimal objective function value

- sim, the simulated vector using optimal parameters
- residuals, the vector of residuals using optimal parameters
- counts, the total number of function calls
- convergence, an integer code indicating reason for completion. 1 maximum iterations reached, 2 relative reduction in function value small. 3 absolute reduction in function value small 4 relative change in parameters small

Examples

```
# Example 1: Rosenbrock
simFunc_rosenbrock=function(x) c(1.0-x[1],10.0*(x[2]-x[1]**2))
rgnOut = rgn(simFunc=simFunc_rosenbrock,
             par=c(-1.0,  0.0), lower=c(-1.5, -1.0), upper=c( 1.5,  3.0),
             simTarget=c(0,0))
rgnOut$par #optimal parameters
rgnOut$value #optimal objective function value

# Example 2: Hymod

data("BassRiver") # load Bass River hydrological data
rgnOut = rgn(simFunc=simFunc_hymod,
             par=c(400.,0.5,0.1,0.2,0.1),
             lower=c(1.,0.1,0.05,0.000001,0.000001),
             upper=c(1000.,2.,0.95,0.99999,0.99999),
             simTarget=BassRiverData$Runoff.mm.day[365:length(BassRiverData$Date)],
           stateVal=c(100.0,30.0,27.0,25.0,30.0,0.0,0.0,0.0), # initial states for hymod
             nWarmUp=365,                                     # warmup period
             rain=BassRiverData$Rain.mm,                      # precip input
             pet=BassRiverData$ET.mm)                         # PET input
rgnOut$par #optimal parameters
rgnOut$value #optimal objective function value
```

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simFunc_hymod *hymod simulation*

Description

Simulation of hymod rainfall-runoff model

Usage

```
simFunc_hymod(
  x,
  rain,
  pet,
  nWarmUp,
  stateVal = c(100, 30, 27, 25, 30, 0, 0, 0)
)
```

Arguments

`x`	parameter values
`rain`	precipitation input (mm/day)
`pet`	potential evapotranspiration (mm/day)
`nWarmUp`	length of warmup period
`stateVal`	(optional) initial states

Value

Vector of simulated runoff

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