

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](https://doi.org/10.1029/2017WR022488)>.

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

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

Depends R (>= 3.5.0)

Suggests testthat (>= 3.0.0)

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BassRiverData	<i>Hydrological data for Bass River catchment in Victoria, Australia</i>
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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	<i>Robust Gauss Newton optimization</i>
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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

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

Details

`rgn` minimizes the objective function $\text{sum}((\text{weights} * (\text{simFunc} - \text{simTarget})^2))$, which is a sum of squared weighted residuals ($\text{residuals} = \text{weights} * (\text{simFunc} - \text{simTarget})$). 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
```

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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* **datasets**

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