Package 'ClamR'

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Type Package

Title Time Series Modeling for Climate Change Proxies

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Imports stats

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Description Implementation of the Wilkinson and Ivany (2002) approach to paleoclimate analysis, applied to isotope data extracted from clams.

License GPL

LazyLoad yes

NeedsCompilation no

Repository CRAN

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Contents

`ClamR-package` *Climate Change with Proxies*

Description

This program implements and improves upon the Wilkinson and Ivany approach to climate time series modeling. The jackknife is used to estimate the 95 percent confidence bounds for the modeled estimates. dx should be chosen to be approximately half a cycle or more.

Author(s)

Jonathan M. Lees

Maintainer: Jonathan M. Lees<jonathan.lees@unc.edu>

References

Wilkinson, B. H. and Ivany, L. C., Paleoclimatic inference from stable isotope profiles of accretionary biogenic hardparts; a quantitative approach to the evaluation of incomplete data, *Palaeogeography, Palaeoclimatology, Palaeoecology*, vol. 185, no. 1-2, pp.95-114, 01 Sep 2002.

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

Examples

```
## Not run:
data(CLAM1)
x = CLAM1$x
y = CLAM1$y

dx = 3.392

gout = proxyJK(x, y, dx)

plotproxy1(x, y, gout)

par(mfrow=c(2,1))

plotproxy.error(x, y, gout, type = 1)
plotproxy.error(x, y, gout, type = 2)


par(mfrow=c(2,1))
plotproxy.error(x, y, gout, type = 2)

plotproxy.all2(gout,YAXstyle=1 )
```

```
## End(Not run)
```

CLAM1 *Clam Proxy Data*

Description

Proxy data from the Orknay Islands

Usage

```
data(CLAM1)
```

Format

The format is: List of 2 $ x: num [1:91] 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 ... $ y: num [1:91] 2.14 2.11 2.4 2.21 2.32 2.44 2.85 2.78 2.27 2.05 ...

Details

Duplicate data has been removed.

Source

One-year data interval (4.68-9.31 mm) of $\delta - 18O$ record of an archaeological limpet Patella vulgata (specimen QG2-1064-1) from Orkney, Scotland (Surge and Barrett, 2012).

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

Examples

```
data(CLAM1)
## maybe str(CLAM1) ; plot(CLAM1) ...
plot(CLAM1$x, CLAM1$y, type="b", xlab="Distance", ylab="d18O" )

## Not run:
###### this is an example from Wang et al.:
####  it takes too long to run on CRAN, but should work

shellx=CLAM1$x[38:70]
shelly=CLAM1$y[38:70]

window_shell=windowsize(shellx,shelly,1.8,9.4,0.2)
```

```
#the window size is 5mm, and make all the plots together
gout_shell = proxyJK(shellx, shelly, 5)

par(mfrow=c(3,2))
plot(shellx,shelly,type="b", xlab="Distance from Margin (mm)",
     ylab=expression(delta*"18O(ppm VPDB)"),
     xlim=c(4,10), ylim = c(1.5,4))
plot((window_shell$win)/2,window_shell$error,xlab="Window Size (mm)",
     ylab="Error",  xlim=c(1.6/2,9.4/2), ylim=c(0,0.5))
abline(v=4.63/2, lty="dotdash",col="black")
abline(v=5/2, col="black")
plotproxy1(shellx, shelly, gout_shell, xlim=c(4,10), ylim = c(1.5,4),
          xlab="Distance from Margin (mm)",
          ylab=expression(delta*"18O(ppm VPDB)"), main="")
plotproxy.all(gout_shell,YAXstyle=1, xlim=c(4,10), ylim1=c(0,4),
              ylim2=c(-15,5))
plotproxy.error(shellx, shelly, gout_shell, type = 1, xlim=c(4,10),
                ylim = c(1.5,4), xlab="Distance from Margin (mm)",
                ylab=expression(delta*"18O(ppm VPDB)"))
plotproxy.error(shellx, shelly, gout_shell, type = 2, xlim=c(4,10),
                ylim = c(1.5,4), xlab="Distance from Margin (mm)",
                ylab=expression(delta*"18O(ppm VPDB)"))




## End(Not run)
```

`climate` *Climate Record At Croig Cave*

Description

Application to modern climate record at Croig Cave and make comparison between reconstructed temperatures and instrumentally measured temperatures.

Usage

```
data("climate")
```

Format

A data frame with 360 observations on the following 3 variables.

`Month` a numeric vector

`overall` a numeric vector

`Temperature` a numeric vector

Source

Monthly sea surface temperature (SST) record for the years 1961-1990 derived from observations near Croig Cave, an archaeological site on the Isle of Mull in the Hebrides Islands west of mainland Scotland (Extended Reconstructed Sea Surface Temperature, Smith and Reynolds, 2004).

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

Examples

```
data(climate)
climate_month <- climate$overall
climate_temp <- climate$Temperature

plot(climate_month,climate_temp,type="l",
    xlab="month",ylab=expression(paste("Temperature ("^"o","C)")))
```

`elliot_yr1` *Elliot Data Summer*

Description

Two years of data from Elliot

Usage

```
data("elliot_yr1")
```

Format

The format is: List of 4 $ date1 : num [1:28] 1995 1995 1995 1995 1995 ... $ d18o1 : num [1:28] -0.036 0.244 0.525 0.332 0.148 -0.43 -0.583 -0.366 -0.641 -0.86 ... $ date_temp1: num [1:31] 1995 1995 1995 1995 1995 ... $ d18o_pred1: num [1:31] -0.58 0 0.54 0.88 0.66 0.35 0.09 -0.09 -0.53 -1.1 ...

Details

Data consists of date, $\delta 18O$, temperature and predicted anomaly for two years of data.

Source

Data sets are selected from the $\delta 18O$ record of a modern Mercenaria mercenaria shell collected live from Cedar Key in northern Florida and analyzed by Elliot et al. (2003). Series elliot_yr1 records one summer (including the most negative $\delta 18O$). Series elliot_yr2 records one winter (including the most positive $\delta 18O$).

Because the modern Mercenaria mercenaria shell by Elliot et al. (2003) is well dated and its in situ records of SST and salinity are available, the predicted $\delta 18O$ are also derived from the local instrumental data. Temp is the predicted $\delta 18O$ for the summer interval of Year1 and Temp2 is the predicted $\delta 18O$ for the winter interval of Year2.

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

Examples

```
data(elliot_yr1)
plot(elliot_yr1$date1,elliot_yr1$d18o1,xlab="Age(years)",
     ylab=expression(delta*'18O(ppm VPDB)'), xlim=c(1994.9,1996.2), ylim=c(-2.5,2))
```

`elliot_yr2` *Elliot Data Winter*

Description

Winter season of data from Elliot data.

Usage

```
data("elliot_yr2")
```

Format

The format is: List of 4 $ date1 : num [1:28] 1995 1995 1995 1995 1995 ... $ d18o1 : num [1:28] -0.036 0.244 0.525 0.332 0.148 -0.43 -0.583 -0.366 -0.641 -0.86 ... $ date_temp1: num [1:31] 1995 1995 1995 1995 1995 ... $ d18o_pred1: num [1:31] -0.58 0 0.54 0.88 0.66 0.35 0.09 -0.09 -0.53 -1.1 ...

Details

Data consists of date, $\delta O18$, temperature and predicted data for winter season of data.

Source

See explanation in elliot_yr1.

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

Examples

```
data(elliot_yr2)
plot(elliot_yr2$date2,elliot_yr2$d18o2,xlab="date(year)",
ylab=expression(delta*'18O(ppm VPDB)'), xlim=c(1995.2,1996.85), ylim=c(-2.5,1.8))
```

`error.bar` *Error bar plot*

Description

Make an X-Y plot with error bars.

Usage

```
error.bar(x, y, lo, hi, pch = 1, col =1, barw = 0.1, add = FALSE, ...)
```

Arguments

`x`	X-values
`y`	Y-values
`lo`	Lower limit of error bars
`hi`	Upper limit of error bars
`pch`	plotting character
`col`	color
`barw`	width of the bar
`add`	logical, add=FALSE starts a new plot
`...`	other plotting parameters

Value

graphical side effects

Author(s)

Jonathan M. Lees<jonathan.lees@unc.edu>

Examples

```
x = 1:10
y = 2*x+5
zup = rnorm(10)
zup = zup-min(zup)+.5
zdown = rnorm(10)
zdown = zdown-min(zdown)+.2
####  example with same error on either side:
error.bar(x, y, y-zup, y+zup, pch = 1, col = 'brown' , barw = 0.1, add =
FALSE)
####  example with different  error on either side:
error.bar(x, y, y-zdown, y+zup, pch = 1, col = 'brown' , barw = 0.1, add
= FALSE)
```

NextPow2 *Next power of 2*

Description

Find the next integer power of 2

Usage

```
NextPow2(x)
```

Arguments

x	integer

Value

integer that is a power of 2 higher than given integer

Author(s)

Jonathan M. Lees<jonathan.lees@unc.edu>

Examples

```
NextPow2(600)
NextPow2(1023)
NextPow2(1025)
```

otolith *otolith Proxy Data*

Description

Early Oligocene otolith from the US Gulf Coast.

Usage

```
data(otolith)
```

Format

A data frame with 63 observations on the following 2 variables.

`distance` a numeric vector

`d18O` a numeric vector

Details

Duplicate data have been removed.

Source

$\delta 18O$ record of an aragonite otolith from the early Oligocene Rosefield Clay in the US Gulf Coast (Ivany, 2000).

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.\

Examples

```
data(otolith)

plot(otolith$distance, otolith$d18O)
```

plotproxy.error *Plot Output Jack-Knife*

Description

Plot output of proxyJK, the jackknife estimate of the time series analysis fitting curves.

Usage

```
plotproxy.error(x,y,gout, type=1, xlim=NULL, ylim=NULL, ylab="", xlab="", main="" )

plotproxy.all(gout, ylab1="", ylab2="",xlab="", main="",
xlim=NULL, ylim1=NULL, ylim2=NULL, legposition="topleft",
YAXstyle=0, pbox=TRUE,
legnames  = c('Phs', 'Pos', 'Amp', 'Prd')  )

plotproxy1(x, y, gout, xlim = NULL, ylim = NULL, ylab = "", xlab = "",
main = "")

plotproxy.error11(x, y, gout, type = 1, xlim = NULL,
ylim = NULL, ylab = "", xlab = "", main = "")

plotproxy.all2(gout, ylab1 = "", ylab2 = "", xlab = "", main = "",
xlim = NULL, ylim1 = NULL, ylim2 = NULL,
 legposition = "topleft", YAXstyle = 0,
pbox = TRUE, legnames = c("Phs", "Pos", "Amp",
 "Prd"))
```

Arguments

x	original x values from file
y	original y values from file
gout	output of proxyJK
type	type of error bar plotting: 1 = bars, 2=shaded
xlim	2-vector(limit on x-axis)
ylim	2-vector(limit on xy-axis)
ylim1	2-vector(limit on xy-axis)
ylim2	2-vector(limit on xy-axis)
ylab	character, y-axis label
ylab1	character, y-axis label
ylab2	character, y-axis label
xlab	character, x-axis label

main	character, title label
legposition	legend position
YAXstyle	Style for Y-axis
pbox	logical
legnames	names for legend

Details

Takes output directly from program

Value

graphical side effects

Author(s)

Jonathan M. Lees<jonathan.lees@unc.edu>

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

See Also

proxyJK

Examples

```
## Not run:
##  example to read in your data from csv file (for non ClamR data

## fn = "donna_viking_1.csv"
## C1 = scan(file=fn, what=list(mm="", o18=""), sep=",")
## x = as.numeric(C1$mm)
## y = as.numeric(C1$o18)
## x = x[!is.na(y)]
## y = y[!is.na(y)]


data(CLAM1)

x = CLAM1$x
y = CLAM1$y

dx = 3.392

gout = proxyJK(x, y, dx)
```

```
plotproxy1(x,y,gout)


## End(Not run)
```

---

proxyA *Optimum Wilkinson Curve Fitting*

Description

Runs one cycle of optimum Wilkinson curve fitting for a single sinusoid fitting.

Usage

```
proxyA(ax, ay, xin)
```

Arguments

ax	x-axis values
ay	y-axis values
xin	starting model: c(Phs,Pos,Amp,Prd)

Details

This program implements the Wilkinson and ivany approach to climate time series modeling. This is used in the more sophisticated proxyJK code.

Value

Optimum model, vector of 4 values

Note

Uses stats package routine optim for optimization

Author(s)

Jonathan M. Lees<jonathan.lees@unc.edu>

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.\

Wilkinson, B. H. and Ivany, L. C., Paleoclimatic inference from stable isotope profiles of accretionary biogenic hardparts; a quantitative approach to the evaluation of incomplete data, *Palaeogeography, Palaeoclimatology, Palaeoecology*, vol. 185, no. 1-2, pp.95-114, 01 Sep 2002

See Also

proxyJK

Examples

```
data(CLAM1)
x = CLAM1$x
y = CLAM1$y

dx = 3.392

Aout = proxyA(x, y, dx)
```

---

proxyJK *Jackknife Wilkinson Curve Fitting*

Description

Perform a jackknife estimate of proxy curve fitting for time series analysis.

Usage

```
proxyJK(x, y, dx)
```

Arguments

x	x-axis values
y	y-axis values
dx	width of window to span in time

Details

Routine that improves on the Wilkinson and Ivany(2002) approach to climate time series modeling. The jackknife is used to estimate the 95 percent confidence bounds for the modeled estimates. dx should be chosen to be approximately half a cycle or more.

Value

List:

OUT	list(par, mid, ax, predmid,JKest, JKvar, PSTILDE)
omids	output midpoints
pmids	values at output midpoints
x	input x
y	input y
predy	predicted y from spline fit

Note

See proxyA for a duplication of the Wilkinson codes.

Author(s)

Jonathan M. Lees<jonathan.lees@unc.edu>

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

See Also

proxyA

Examples

```
## Not run:

##########   this is for reading in data
########  fn = "/home/lees/DONNA/donna_viking_1.csv"

## fn = "donna_viking_1.csv"
######## C1 = scan(file=fn, what=list(mm="", o18=""), sep=",")
######## x = as.numeric(C1$mm)
######## y = as.numeric(C1$o18)
########x = x[!is.na(y)]
########y = y[!is.na(y)]


data(CLAM1)
x = CLAM1$x
y = CLAM1$y

dx = 3.392

gout = proxyJK(x, y, dx)

plotproxy1(x, y, gout)

par(mfrow=c(2,1))

plotproxy.error(x, y, gout, type = 1)
plotproxy.error(x, y, gout, type = 2)


par(mfrow=c(2,1))
plotproxy.error(x, y, gout, type = 2)
```

```
plotproxy.all2(gout, YAXstyle=1 )


## End(Not run)
```

RESCALE *Rescale a vector to fit in a certain range*

Description

Rescale a vector to fit in a certain range

Usage

```
RESCALE(x, nx1, nx2, minx, maxx)
```

Arguments

x	vector
nx1	new minimum
nx2	new maximum
minx	old min
maxx	old max

Details

Used for graphics.

Value

scale vector is returned

Author(s)

Jonathan M. Lees<jonathan.lees.edu>

Examples

```
x = rnorm(10)
RESCALE(x, 3, 9, min(x), max(x) )
```

rwp_limpet *Reconstructed Temperature Record*

Description

Application to estimated temperatures from archaeological RWP shell 103a-39-1 with 3 years of temperature data.

Usage

```
data("rwp_limpet")
```

Format

A data frame with 74 observations on the following 8 variables.

`distance_all` a numeric vector

`temp_all` a numeric vector

`distance1` a numeric vector

`temp1` a numeric vector

`distance2` a numeric vector

`temp2` a numeric vector

`distance3` a numeric vector

`temp3` a numeric vector

Source

RWP shell 103a-39-1

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

Examples

```
data(rwp_limpet)
plot(rwp_limpet$distance_all, rwp_limpet$temp_all, type='b')
```

SinMod *Sine Model of climate time series*

Description

Sine Model of climate time series

Usage

```
SinMod(x, myEx, dC2)
```

Arguments

x	input model x consisting of 4 values, phase, position, amplitude, period
myEx	externally defined X-values
dC2	externally defined observations at X

Details

This is the function used in optimization of sinusoidal fits to climate data.

Value

squared sum of difference between obsereved and predicted

Note

Uses stats package for optimization

Author(s)

Jonathan M. Lees<jonathan.lees@unc.edu>

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

See Also

optim, proxyA, proxyJK

Examples

```
data(CLAM1)
x = CLAM1$x
y = CLAM1$y
 dx = 3.392

A1 = proxyA(x, y, dx)

RMSout = SinMod(A1$par, x, y)
```

`windowsize` *Find Window Size*

Description

Estimate optimal window size for seasonal time series analysis.

Usage

```
windowsize(x, y, winmin, winmax, winstep)
```

Arguments

`x`	original x values from file
`y`	original y values from file
`winmin`	Minimum window size
`winmax`	Maximum window size
`winstep`	step size

Value

`win`	optimum window length
`error`	error for win

Author(s)

Jonathan M. Lees<jonathan.lees@unc.edu>

References

Wang, T., Surge, D., and Lees, J. M., (2015) ClamR: A Statistical Evaluation of Isotopic and Temperature Records in Sclerochronologic Studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi:10.1016/j.palaeo.2015.07.008.

Examples

```
## Not run:
data(CLAM1)
shellx=CLAM1$x[38:70]
shelly=CLAM1$y[38:70]

window_shell=windowsize(shellx,shelly,1.8,9.4,0.2)


## End(Not run)
```

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