

Package ‘RGENERATEPREC’

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Maintainer Emanuele Cordano <emanuele.cordano@gmail.com>

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Title Tools to Generate Daily-Precipitation Time Series

Type Package

Author Emanuele Cordano

Description The method 'generate()' is extended for spatial multi-site stochastic generation of daily precipitation. It generates precipitation occurrence in several sites using logit regression (Generalized Linear Models) and the approach by D.S. Wilks (1998) <[doi:10.1016/S0022-1694\(98\)00186-3](https://doi.org/10.1016/S0022-1694(98)00186-3)> .

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VignetteBuilder knitr

URL <https://github.com/ecor/RGENERATEPREC>

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CCGamma	<i>This function extends continuity_ratio and adds the corresponding gaussian correlation matrix for no-precipitation occurrence.</i>
---------	---

Description

This function extends [continuity_ratio](#) and adds the corresponding gaussian correlation matrix for no-precipitation occurrence.

Usage

```
CCGamma(
  data,
  lag = 0,
  p0_v1 = NULL,
  p = NA,
  valmin = 0.5,
  nearPD = (lag >= 0),
  interval = c(-1, 1),
  tolerance = .Machine$double.eps,
  only.matrix = FALSE,
  return.value = NULL,
  null.gcorrelation = 1e-05,
  sample = NULL,
  origin = "1961-1-1",
  ...
)
```

Arguments

data	data frame or 'zoo' R object containing daily precipitation time series for several gauges (one gauge time series per column). See continuity_ratio .
lag	numeric lag (expressed as number of days) used for computation for "cross" continuity ratio and joint probability of precipitation (no)occurrence. See continuity_ratio .
p0_v1	vector for marginal probabilities, see omega and omega_inv .
p	positive integer parameter. Default is NA, otherwise, lag is calculated as the vector 0:p.
valmin	threshold precipitation value [mm] for wet/dry day indicator. If precipitation is lower than valmin, day is considered dry. Default is 0.5 mm. See continuity_ratio .

nearPD	see omega_inv . Default is (lag==0).
interval, tolerance	see omega_inv
only.matrix	logical value. If TRUE the function returns only the gaussian correlaton matrix. Deaful is FALSE.
return.value	string. If it is not either NULL (Default) and NA, function returns only the argu-ment indicated by this argument.
null.gcorrelation	numerical value nooccurrence_gcorrelation under which is considered to be 0.
sample	character string indicated if function must be calculated differently for sub-set of the year, e.g. monthly. Admitted values are NULL (Default), "all" or "monthly".
origin	character string (yyyy-dd-mm) indicated the date of the first row of "data". It is used if data and sample are not NULL.
...	additional agruments of omega_inv or CCGamma

Value

An object which is a list containing the following fields:

`continuity_ratio` : lag-day lagged continuity ratio, as returned by [continuity_ratio](#);

`occurrence` : joint probability of lag-day lagged precipitation occurrence, as returned by [continuity_ratio](#);

`nooccurrence` : joint probability of lag-day lagged no precipitation occurrence, as returned by [continuity_ratio](#);

`lag` : number of days lagged between the two compared events (see argument `lag`);

`p0_v1` : vector of marginal probability of no precipitation occurrence. If `lag` is 0, it corresponds to the diagonal of nooccurrence matrix (see argument `p0_v1`);

`nooccurrence_gcorrelation` corresponding gaussian correlation for no precipitation occurrence obtained by applying [omega_inv](#) to nooccurrence,

If the argument `only.matrix` is TRUE, only `nooccurrence_gcorrelation` is returned as a matrix. In case the argument `lag` is a vector wirh length more than one, the function returns a list of the above-cited return object for each value of the vector `lag`.

Note

This functon is useful to generate the serial cross-correlation matrices for no precipitation occur-rence for Yule-Walker Equations. In case `lag` is a vactor, `nearPD` must be a vector of the same size, default is (lag==0).

See the R code for major details

Author(s)

Emanuele Cordano

CCGammaToBlockmatrix *This function returns a [blockmatrix](#) object containing the gaussian cross-correlation matrices.*

Description

This function returns a [blockmatrix](#) object containing the gaussian cross-correlation matrices.

Usage

```
CCGammaToBlockmatrix(data, lag = 0, p = 3, ...)
```

Arguments

data	data frame or 'zoo' R object containing daily precipitation time series for several gauges (one gauge time series per column). See CCGamma .
lag	numeric (expressed as number of days) used for the element [1,1] of the returned blockmatrix .
p	numeric order \$p\$ of the auto-regeression
...	further arguments of CCGamma

Details

This a wrapper for [CCGamma](#) with the option `only.matrix=TRUE` and the function value is transformed into a [blockmatrix](#) object.

Value

A [blockmatrix](#) object containing the gaussian cross-correlation matrices.

See Also

[CCGamma](#), [continuity_ratio](#), [omega_inv](#), [omega](#)

Examples

```
data(trentino)

year_min <- 1961
year_max <- 1990

period <- PRECIPITATION$year >= year_min & PRECIPITATION$year <= year_max
station <- names(PRECIPITATION)[!(names(PRECIPITATION) %in% c("day", "month", "year"))]
prec_mes <- PRECIPITATION[period, station]

## removing nonworking stations (e.g. time series with NA)
accepted <- array(TRUE, length(names(prec_mes)))
```

```

names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  accepted[it] <- (length(which(!is.na(prec_mes[,it])))==length(prec_mes[,it]))
}

prec_mes <- prec_mes[,accepted]
## the dataset is reduced!!!
prec_mes <- prec_mes[,1:2]

p <- 1 ## try p <- 2 !!!
CCGamma <- CCGammaToBlockmatrix(data=prec_mes,lag=0,p=p,tolerance=0.001)

## Not Run in the examples, uncomment to run the following line
CCGamma_1 <- CCGammaToBlockmatrix(data=prec_mes,lag=1,p=p,tolerance=0.001)

### Alternatively, recommended .....
## Not Run in the examples, uncomment to run the following line
CCGamma <- CCGammaToBlockmatrix(data=prec_mes,lag=0,p=p+1,tolerance=0.001)

CCGamma0 <- CCGamma[1:p,1:p]
CCGamma1 <- CCGamma[(1:p),(1:p)+1]

CCGamma0_inv <- solve(CCGamma0)

## Not Run in the examples, uncomment to run the following line
a1 <- blockmatmult(CCGamma0,CCGamma0_inv)
a2 <- blockmatmult(CCGamma1,CCGamma0_inv)

CCGamma_1t <- t(CCGamma1)
CCGamma_0t <- t(CCGamma0)

A <- t(solve(CCGamma_0t,CCGamma_1t))

```

dw.spell

It calculates dry/wet spell duration.

Description

It calculates dry/wet spell duration.

Usage

```
dw.spell(
```

```

    data,
    valmin = 0.5,
    origin = "1961-1-1",
    extract = NULL,
    month = 1:12,
    melting.df = FALSE,
    from.start = FALSE,
    only.inner = FALSE
  )

```

Arguments

data	data frame R object containing daily precipitation time series for several gauges (one gauge time series per column).
valmin	threshold precipitation value [mm] for wet/dry day indicator.
origin	character string "yyyy-mm-dd" indicated the date of the first row of "data".
extract	string character referred to the state to be extracted, eg. "dry" or "wet"
month	integer vectors containing the considered months. Default is 1:12 (all the year).
melting.df	logical value. If it TRUE the output is melted into a data frame. Default is FALSE.
from.start	logical value. If is TRUE the spell is referenced to its first day, if it is FALSE (default) the spell is referenced to its last date.
only.inner	logical value. It is used in case extract is not NULL, if the value is TRUE, it extracts dry/wet spells completely inside the selected month period. Default is FALSE.

Value

Function returns a list of data frames containing the spell length expressed in days

Examples

```

data(trentino)

year_min <- 1961
year_max <- 1990

period <- PRECIPITATION$year>=year_min & PRECIPITATION$year<=year_max
station <- names(PRECIPITATION)[!(names(PRECIPITATION) %in% c("day", "month", "year"))]
prec_mes <- PRECIPITATION[period,station]

## removing nonworking stations (e.g. time series with NA)
accepted <- array(TRUE,length(names(prec_mes)))
names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  accepted[it] <- (length(which(!is.na(prec_mes[,it])))==length(prec_mes[,it]))
}

```

```

prec_mes <- prec_mes[,accepted]
## the dataset is reduced!!!
prec_mes <- prec_mes[,1:3]

origin <- paste(year_min,1,1,sep="-")
dw_spell <- dw.spell(prec_mes,origin=origin)
dw_spell_dry <- dw.spell(prec_mes,origin=origin,extract="dry")

hist(dw_spell_dry$T0001$spell_length)

## Single Gauging Station

prec_mes <- prec_mes[,1]

origin <- paste(year_min,1,1,sep="-")
dw_spell <- dw.spell(prec_mes,origin=origin)
dw_spell_dry <- dw.spell(prec_mes,origin=origin,extract="dry")
dw_spell_dry_start <- dw.spell(prec_mes,origin=origin,extract="dry",
month=5:8,from.start=TRUE) ## dry spell
dw_spell_dry_start_2 <- dw.spell(prec_mes,origin=origin,extract="dry",
month=5:8,from.start=TRUE,only.inner=TRUE) ## dry spell
## is referenced to the first day instead of the latest one as default.

hist(dw_spell_dry[[1]]$spell_length)

```

```

generate.PrecipitationOccurrenceModel
      Stochastic Generation of a PrecipitationOccurrenceModel or
      PrecipitationOccurrenceMultiSiteModel model object

```

Description

It is an implementation of [generate](#) method

Usage

```

## S3 method for class 'PrecipitationOccurrenceModel'
generate(
  x,
  newdata = NULL,
  previous = NULL,
  n = 30,
  random = runif(n, min = 0, max = 1),
  exogen = NULL,
  monthly.factor = NULL,

```



```

    ...
)

## S3 method for class 'CCGammaObjectListPerEachMonth'
generate(x, ...)

## S3 method for class 'PrecipitationOccurrenceMultiSiteModel'
generate(
  x,
  exogen,
  n = 10,
  origin = "1961-1-1",
  end = "1990-1-1",
  previous = NULL,
  monthly.factor = NULL,
  ...
)

## S3 method for class 'PrecipitationAmountModel'
generate(x, ...)

```

Arguments

x	model returned by PrecipitationOccurrenceModel or PrecipitationOccurrenceMultiSiteModel
newdata	predictor or exogenous variables. See predict.PrecipitationOccurrenceModel
previous	logical vector containing previously occurred states
n	number of generations. See generate . Here it is ignored and the number of generations is given by origin,end or monthly.factor.
random	vector of random or calculated numbers ranging between 0 and 1
exogen	predictor or exogenous variables
monthly.factor	vector of factors indicating the month of the days
...	further arguments
origin, end	character strings (yyyy-dd-mm) indicating the start and/or end date of the daily weather generation.

Value

A vector or a data frame reporting generated time series for each station.

References

- D.S. Wilks (1998), Multisite Generalization of a Daily Stochastic Precipitation Generation Model, *Journal of Hydrology*, Volume 210, Issues 1-4, September 1998, Pages 178-191, <https://www.sciencedirect.com/science/article/pii/S0022169498001863>
- Muamaraldin Mhanna and Willy Bauwens (2011) A Stochastic Space-Time Model for the Generation of Daily Rainfall in the Gaza Strip, *International Journal of Climatology*, Volume 32, Issue 7, pages 1098-1112, doi: [10.1002/joc.2305](https://doi.org/10.1002/joc.2305), <https://rmets.onlinelibrary.wiley.com/doi/abs/10.1002/joc.2305>

See Also

[generate](#), [predict.glm](#), [PrecipitationOccurrenceModel](#), [PrecipitationOccurrenceMultiSiteModel](#)

Examples

```
library(RGENERATEPREC)

## A function example can be found in the following script file:
scriptfile <- system.file("example.generate.R",package="RGENERATEPREC")
## The current file path is given by 'scriptfile' variable:
print(scriptfile)
## To run the example file, launch the file with 'source' command (uncomment the following line)
#source(scriptfile)

## ALTERNATIVELY you can run the following lines:

data(trentino)

year_min <- 1961
year_max <- 1990

origin <- paste(year_min,1,1,sep="-")
end <- paste(year_max,12,31,sep="-")

period <- PRECIPITATION$year>=year_min & PRECIPITATION$year<=year_max
period_temp <- TEMPERATURE_MAX$year>=year_min & TEMPERATURE_MAX$year<=year_max

prec_mes <- PRECIPITATION[period,]
Tx_mes <- TEMPERATURE_MAX[period_temp,]
Tn_mes <- TEMPERATURE_MIN[period_temp,]
accepted <- array(TRUE,length(names(prec_mes)))
names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  acc <- TRUE
  acc <- (length(which(!is.na(Tx_mes[,it])))==length(Tx_mes[,it]))
  acc <- (length(which(!is.na(Tn_mes[,it])))==length(Tn_mes[,it])) & acc
  accepted[it] <- (length(which(!is.na(prec_mes[,it])))==length(prec_mes[,it])) & acc
}

valmin <- 1.0
prec_mes <- prec_mes[,accepted]

Tx_mes <- Tx_mes[,accepted]
Tn_mes <- Tn_mes[,accepted]
prec_occurrence_mes <- prec_mes>=valmin
```

```

station <- names(prec_mes)[!(names(prec_mes) %in% c("day", "month", "year"))]
it <- station[2]
vect <- Tx_mes[,it]-Tn_mes[,it]
months <- factor(prec_mes$month)

model <-
PrecipitationOccurrenceModel(x=prec_mes[,it],exogen=vect,
monthly.factor=months,valmin=valmin)

obs <- prec_mes[,it]>=valmin

gen <- generate(model,exogen=vect,monthly.factor=months,n=length(months))

### MultiSite Generation

station <- station[1:2]
exogen <- Tx_mes[,station]-Tn_mes[,station]

months <- factor(prec_mes$month)

model_multisite <-
PrecipitationOccurrenceMultiSiteModel(x=prec_mes[,station],
exogen=exogen,origin=origin,multisite_type="wilks")

## LOGIT-type Model
model_multisite_logit <-
PrecipitationOccurrenceMultiSiteModel(x=prec_mes,exogen=exogen,
origin=origin,multisite_type="logit",station=station)

obs_multisite <- prec_mes[,station]>=valmin

gen_multisite <- generate(model_multisite,exogen=exogen,origin=origin,end=end)

gen_multisite_logit <- generate(model_multisite_logit,exogen=exogen,origin=origin,end=end)

```

nwetdays

It calculates the number of wet days for each month and each year

Description

It calculates the number of wet days for each month and each year

Usage

```
nwetdays(data, valmin = 0.5, origin = "1961-1-1", station = names(data))
```

Arguments

<code>data</code>	data frame R object containing daily precipitation time series for several gauges (one gauge time series per column).
<code>valmin</code>	threshold precipitation value [mm] for wet/dry day indicator.
<code>origin</code>	character string "yyyy-mm-dd" indicated the date of the first row of "data".
<code>station</code>	character string indicating the stations. Default is names(data)

Value

Function returns a list of data frames containing the spell length expressed in days

Examples

```
data(trentino)

year_min <- 1961
year_max <- 1990

period <- PRECIPITATION$year>=year_min & PRECIPITATION$year<=year_max
station <- names(PRECIPITATION)[!(names(PRECIPITATION) %in% c("day", "month", "year"))]
prec_mes <- PRECIPITATION[period,station]

## removing nonworking stations (e.g. time series with NA)
accepted <- array(TRUE,length(names(prec_mes)))
names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  accepted[it] <- (length(which(!is.na(prec_mes[,it])))==length(prec_mes[,it]))
}

prec_mes <- prec_mes[,accepted]
## the dataset is reduced!!!
prec_mes <- prec_mes[,1:3]

origin <- paste(year_min,1,1,sep="-")

nwetdays <- nwetdays(prec_mes,origin)
```

omega	<i>This function finds the bivariate joint probability or the binary correlation from the corresponding Gaussian correlation x</i>
-------	--

Description

This function finds the bivariate joint probability or the binary correlation from the corresponding Gaussian correlation x

Usage

```
omega(x = 0.5, p0_v1 = 0.5, p0_v2 = NA, correlation = FALSE)
```

Arguments

x	value of expected correlation between the corresponding Gaussian-distributed variables
p0_v1, p0_v2	probability of no precipitation occurrences for the v1 and v2 time series respectively. See Notes.
correlation	logical numeric value. Default is FALSE. If TRUE the function returns the binary correlation like eq. 6 of Mhanna, et al.,2011.

Value

probability of no precipitation occurrence in both v1 and v2 simultaneously. It is a matrix if x is a matrix.

Note

This function makes use of normal copula. A graphical introduction to this function (with its inverse) makes is present in the following URL references: <https://rmets.onlinelibrary.wiley.com/doi/abs/10.1002/joc.2305> and <https://www.sciencedirect.com/science/article/pii/S0022169498001863> (See fig. 1 and par. 3.2) If the argument p0_v2, the two marginal probability values must be given as a vector through the argument p0_v1: $p0_v1=c(p0_v1,p0_v2)$. In case x is a correlation/covariance matrix the marginal probabilities are given as a vector through the argument p0_v1.

Author(s)

Emanuele Cordano

References

D.S. Wilks (1998), Multisite Generalization of a Daily Stochastic Precipitation Generation Model, Journal of Hydrology, Volume 210, Issues 1-4, September 1998, Pages 178-191, <https://www.sciencedirect.com/science/article/pii/S0022169498001863>

Muamaraldin Mhanna and Willy Bauwens (2011) A Stochastic Space-Time Model for the Generation of Daily Rainfall in the Gaza Strip, International Journal of Climatology, Volume 32, Issue 7, pages 1098-1112, doi: [10.1002/joc.2305](https://doi.org/10.1002/joc.2305), <https://rmets.onlinelibrary.wiley.com/doi/abs/10.1002/joc.2305>

See Also

[normalCopula](#), [pcopula](#)

Examples

```
rho <- 0.4
p00 <- omega(x=rho,p0_v1=0.5,p0_v2=0.5)
cor00 <- omega(x=rho,p0_v1=0.5,p0_v2=0.5,correlation=TRUE)
```

omega_inv

This function is the inverse of [omega](#) function

Description

This function is the inverse of [omega](#) function

Usage

```
omega_inv(
  p0 = NULL,
  p0_v1 = 0.5,
  p0_v2 = p0_v1,
  p00 = p0_v1 * p0_v2,
  correlation = NA,
  only.value = TRUE,
  interval = c(-1, 1),
  tolerance = 0.001,
  nearPD = TRUE,
  force.independence = TRUE,
  ...
)
```

Arguments

p0	matrix of joint probabilities. Default is NULL, otherwise functions returns a matrix with values
p0_v1, p0_v2	probability of no precipitatin occurrences for the v1 and v2 time series respectively.
p00	probability of no precipitation occurrence in both v1 and v2 simultaneously returned by omega

correlation	numerical value. Default is NA. Binary correlation returned by omega when the argument correlation=TRUE (see omega_root)
only.value	logical value. If TRUE (Default) the only Gaussian correlation (x input variable of omega) is returned, otherwise the complete output of uniroot is returned.
interval	see interval option of uniroot . Default is c(-1, 1).
tolerance	tolerance (numeric) parameter used for comparisons with the extreme value of marginal probabilities. Default is 0.001.
nearPD	logical. If TRUE (Default) a positive-definite correlation matrix is returned by applying nearPD in case p0 is a matrix and not NULL.
force.independence	logical value. Default is TRUE. If it is TRUE, no negative correlation is considered and negative values of correlation are forced to be 0 (independence).
...	further arguments for uniroot

Value

value of expected correlation between the corresponding Gaussian-distributed variables (see x input argument of [omega](#)).

Note

This function finds the zero of the [omega_root](#) function by calling [uniroot](#). If the argument p0 is not NULL and is a matrix of joint probabilities, the function returns a correlation matrix by using the elements of p0 as joint probabilities for each couple and p0_v1 as a vector of marginal probability of each occurrence/no-occurrence (In this case if the length of p0_v1 does not correspond to the number of columns of p0, the marginal probabilities are taken from the diagonal of p0). See the R code for major details.

Author(s)

Emanuele Cordano

See Also

[normalCopula](#), [pcopula](#), [omega](#) (and reference URLs therein)

Examples

```
x <- omega_inv(p0_v1=0.5, p0_v2=0.5, p00=1.1*0.5*0.5)
omega(x, p0_v1=0.5, p0_v2=0.5)
```

omega_root	<i>This is the target function whose zero is searched to create the inverse function of omega.</i>
------------	--

Description

This is the target function whose zero is searched to create the inverse function of [omega](#).

Usage

```
omega_root(
  x = 0.5,
  p0_v1 = 0.5,
  p0_v2 = 0.5,
  p00 = p0_v1 * p0_v2,
  correlation = NA
)
```

Arguments

x	value of expected correlation between the corresponding Gaussian-distributed variables
p0_v1, p0_v2	probability of no precipitation occurrences for the v1 and v2 time series respectively.
p00	probability of no precipitation occurrence in both v1 and v2 simultaneously returned by omega
correlation	numerical value. Default is NA. Binary correlation returned by omega when the argument correlation=TRUE

Value

the value `p00-omega(x=x,p0_v1=p0_v1,p0_v2=p0_v2)` or `correlation-omega(x=x,p0_v1=p0_v1,p0_v2=p0_v2)` (if correlation is not NA)

Note

This function makes use of normal copula

Author(s)

Emanuele Cordano

See Also

[normalCopula](#), [pcopula](#), [omega](#), [omega_inv](#)

Examples

```
rho <- 0.4
p00 <- omega(x=rho,p0_v1=0.5,p0_v2=0.5)
omega_root(x=rho,p0_v1=0.5,p0_v2=0.5,p00=p00)
```

```
PrecipitationAmountModel
```

Creates a Precipitation Amount Model

Description

Creates a Precipitation Amount Model

Usage

```
PrecipitationAmountModel(
  x,
  valmin = 1,
  station = names(x),
  sample = "monthly",
  origin = "1961-1-1",
  ...
)
```

Arguments

x	observed precipitation amount time series (data frame)
valmin	maximum admitted value of precipitation depth
station	string vector containing station identification codes
sample	character string. If it is "monthly" (Default), the corralaton matrix is calculated per each month.
origin	date of the day referred by he first row of x.
...	further agruments for normalizeGaussian_severalstations

Value

The function returns AN S3 OBJECT the correlation matrix of precipitation amount values (excluding the zeros). In case sample=="monthly" the function return a MonlthyList S3 object.

See Also

[predict.PrecipitationAmountModel](#),[normalizeGaussian_severalstations](#),[generate](#)

Examples

```

set.seed(1245)

data(trentino)

year_min <- 1961
year_max <- 1990

origin <- paste(year_min,1,1,sep="-")
end <- paste(year_max,12,31,sep="-")

period <- PRECIPITATION$year>=year_min & PRECIPITATION$year<=year_max
period_temp <- TEMPERATURE_MAX$year>=year_min & TEMPERATURE_MAX$year<=year_max

prec_mes <- PRECIPITATION[period,]
Tx_mes <- TEMPERATURE_MAX[period_temp,]
Tn_mes <- TEMPERATURE_MIN[period_temp,]
accepted <- array(TRUE,length(names(prec_mes)))
names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  acc <- TRUE
  acc <- (length(which(!is.na(Tx_mes[,it])))==length(Tx_mes[,it]))
  acc <- (length(which(!is.na(Tn_mes[,it])))==length(Tn_mes[,it])) & acc
  accepted[it] <- (length(which(!is.na(prec_mes[,it]))==length(prec_mes[,it])) & acc
}

valmin <- 1.0
prec_mes <- prec_mes[,accepted]

Tx_mes <- Tx_mes[,accepted]
Tn_mes <- Tn_mes[,accepted]
prec_occurrence_mes <- prec_mes>=valmin

station <- names(prec_mes)[!(names(prec_mes) %in% c("day","month","year"))]

precamount <- PrecipitationAmountModel(prec_mes,station=station,origin=origin)

val <- predict(precamount)

prec_gen <- generate(precamount)

month <- adddate(as.data.frame(residuals(precamount$T0090)),origin=origin)$month
####plot(month,residuals(precamount$T0090))
plot(factor(month),residuals(precamount$T0090))

```

```
qqplot(prec_mes$T0083,prec_gen$T0083)
abline(0,1)

## SINGLE STATION

station <- "T0083"

precamount_single <- PrecipitationAmountModel(prec_mes,station=station,origin=origin)

val_single <- predict(precamount_single)

prec_gen_single <- generate(precamount_single)

month <- adddate(as.data.frame(residuals(precamount_single[[station[1]]])),origin=origin)$month
plot(factor(month),residuals(precamount_single[[station[1]]]))

### Comparison (Q-Q plot) between multi and single sites.

qqplot(prec_mes$T0083,prec_gen$T0083,col=1)
abline(0,1)
points(sort(prec_mes$T0083),sort(prec_gen_single$T0083),pch=2,col=2)
legend("bottomright",pch=c(1,2),col=c(1,2),legend=c("Multi Sites","Single Site"))

abline(0,1)
```

PrecipitationOccurrenceModel

Precipitation Occurrence Model

Description

This functions creates a stochastic Occurrence Model for the variable x (PrecipitationOccurrenceModel S3 object) through a calibration from observed data.

Usage

```
PrecipitationOccurrenceModel(
  x,
  exogen = NULL,
  p = 1,
  monthly.factor = NULL,
  valmin = 0.5,
  id.name = NULL,
  ...
)
```

Arguments

x	variable utilized for the auto-regression of its occurrence, e.g. daily precipitaton
exogen	exogenous predictors
p	auto-regression order
monthly.factor	vector of factors indicating the month of the days
valmin	minimum admitted value for daily precipitation amount
id.name	identification name of the station
...	further arguments

Value

The function returns a `PrecipitationOccurrenceModel`-class S3 object containing the following elements:

`predictor` data frame containg the endogenous and exogenous predictors of the logistic regression model;

`glm` the generalized liner model using for the logistic regression;

`p` auto-regression order

`valmin` minimum admitted value for daily precipitation amount

See Also

[glm](#)

Examples

```
library(RGENERATEPREC)

data(trentino)

year_min <- 1961
year_max <- 1990

period <- PRECIPITATION$year>=year_min & PRECIPITATION$year<=year_max
```

```

period_temp <- TEMPERATURE_MAX$year>=year_min & TEMPERATURE_MAX$year<=year_max

prec_mes <- PRECIPITATION[period,]
Tx_mes <- TEMPERATURE_MAX[period_temp,]
Tn_mes <- TEMPERATURE_MIN[period_temp,]
accepted <- array(TRUE,length(names(prec_mes)))
names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  acc <- TRUE
  acc <- (length(which(!is.na(Tx_mes[,it])))==length(Tx_mes[,it]))
  acc <- (length(which(!is.na(Tn_mes[,it])))==length(Tn_mes[,it])) & acc
  accepted[it] <- (length(which(!is.na(prec_mes[,it])))==length(prec_mes[,it])) & acc
}

valmin <- 1.0
prec_mes <- prec_mes[,accepted]

Tx_mes <- Tx_mes[,accepted]
Tn_mes <- Tn_mes[,accepted]
prec_occurrence_mes <- prec_mes>=valmin

station <- names(prec_mes)[!(names(prec_mes) %in% c("day","month","year"))]
it <- station[2]
vect <- Tx_mes[,it]-Tn_mes[,it]
months <- factor(prec_mes$month)
model <- PrecipitationOccurrenceModel(x=prec_mes[,it],exogen=vect,monthly.factor=months)

probs <- predict(model$glm,type="response")

plot(months[-1],probs)

newdata <- model$predictor[2000:2007,]
probs0 <- predict(model,newdata=newdata)

```

```
PrecipitationOccurrenceMultiSiteModel
```

Precipitation Occurrence Multi-Site Model

Description

This function creates a stochastic Occurrence Multi-Site Model for the variable `x` (PrecipitationOccurrenceMultiSiteModel S3 object) through a calibration from observed data.

Usage

```
PrecipitationOccurrenceMultiSiteModel(
  x,
  exogen = NULL,
  station = names(x),
  origin = origin,
  valmin = 0.5,
  multisite_type = "wilks",
  tolerance_wilks = 0.001,
  p = 2,
  ...
)
```

Arguments

<code>x</code>	data frame (each column is a site) of variable utilized for the auto-regression of its occurrence, e.g. daily precipitaton
<code>exogen</code>	exogenous predictors
<code>station</code>	character string vectors containing the codes of the station used for model calibration
<code>origin</code>	character string (yyyy-dd-mm) indicating the date of the first row of " <code>x</code> ".
<code>valmin</code>	minimum admitted value for daily precipitation amount
<code>multisite_type</code>	string indicating the utilized approach for spatial multi-site dependence description. Default is "wilks".
<code>tolerance_wilks</code>	see tolerance used by omega_inv through CCGamma
<code>p</code>	auto-regression order
<code>...</code>	further arguments

Value

The function returns a PrecipitationOccurrenceModel-class S3 object containing the following elements:

... [PrecipitationOccurrenceModel](#) S3 class objects for each analyzed site. The name is the site (or station) code

`cgamma` [CCGammaObjectListPerEachMonth](#) object, i.e. matrices of Gaussian Inter-Site Correlation returned by [CCGamma](#);

`type` string indicating the utilized approach for spatial multi-site dependence description, only "wilks" type is implemented;

`station` character string vectors containing the codes of the station used in [PrecipitationMultiSiteOccurrenceModel](#).

See Also

[PrecipitationOccurrenceModel,CCGamma](#)

Examples

```

library(RGENERATEPREC)

data(trentino)

year_min <- 1961
year_max <- 1990
origin <- paste(year_min,1,1,sep="-")

period <- PRECIPITATION$year>=year_min & PRECIPITATION$year<=year_max
period_temp <- TEMPERATURE_MAX$year>=year_min & TEMPERATURE_MAX$year<=year_max

prec_mes <- PRECIPITATION[period,]
Tx_mes <- TEMPERATURE_MAX[period_temp,]
Tn_mes <- TEMPERATURE_MIN[period_temp,]
accepted <- array(TRUE,length(names(prec_mes)))
names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  acc <- TRUE
  acc <- (length(which(!is.na(Tx_mes[,it])))==length(Tx_mes[,it]))
  acc <- (length(which(!is.na(Tn_mes[,it])))==length(Tn_mes[,it])) & acc
  accepted[it] <- (length(which(!is.na(prec_mes[,it]))==length(prec_mes[,it])) & acc
}

valmin <- 1.0
prec_mes <- prec_mes[,accepted]

Tx_mes <- Tx_mes[,accepted]
Tn_mes <- Tn_mes[,accepted]
prec_occurrence_mes <- prec_mes>=valmin

station <- names(prec_mes)[!(names(prec_mes) %in% c("day","month","year"))]
station <- station[1:2] # to save example elapsed time!!
exogen <- Tx_mes-Tn_mes
months <- factor(prec_mes$month)

#' ### Not Run!!
# The following lines are commented to save example elapsed time!!
model_multisite <- PrecipitationOccurrenceMultiSiteModel(x=prec_mes,exogen=exogen,
origin=origin,multisite_type="wilks")

### Not Run!!
# The following lines are commented to save example elapsed time!!
model_multisite_logit <- PrecipitationOccurrenceMultiSiteModel(x=prec_mes,exogen=exogen,

```

```
origin=origin,multisite_type="logit")
```

```
predict.PrecipitationOccurrenceModel
```

```
Prediction of a PrecipitationOccurrenceModel model object
```

Description

It is a wrapper of `predict.glm` method for the a `PrecipitationOccurrenceModel` model object S3 class.

Usage

```
## S3 method for class 'PrecipitationOccurrenceModel'
predict(
  object,
  newdata = NULL,
  type = "response",
  previous = NULL,
  endogenous = NULL,
  ...
)

## S3 method for class 'PrecipitationOccurrenceMultiSiteModel'
predict(object, ...)
```

```
## S3 method for class 'PrecipitationAmountModel'
predict(
  object,
  newdata = NULL,
  origin_newdata = NA,
  precipitation.value.random.generation = FALSE,
  ...
)
```

Arguments

<code>object</code>	model returned by PrecipitationOccurrenceModel
<code>newdata</code>	predictor or exogenous variables
<code>type</code>	see predict.glm . Default is "response". See predict.glm .
<code>previous</code>	logical vector containing previously occurred states.
<code>endogenous</code>	String vector containing the name of the endogenous variables. It is used if the endogenous variables are more than one, otherwise is set NULL(Default).
<code>...</code>	further arguments

origin_newdata character string containing the date corresponding the first row of newdata
 precipitation.value.random.generation
 logical value. If it is FALSE (Default) the method predict.PrecipitationAmountModel returns conditioned random values, otherwise these values are converted to precipitation values through their observed non-parametric distributions.

Value

A vector or a data frame reporting predicted time series for each station.

See Also

[predict.glm,PrecipitationOccurrenceModel](#)

[predict.glm,predict.glm,PrecipitationOccurrenceModel,PrecipitationAmountModel](#)

Examples

```
library(RGENERATEPREC)

data(trentino)

year_min <- 1961
year_max <- 1990

period <- PRECIPITATION$year>=year_min & PRECIPITATION$year<=year_max
period_temp <- TEMPERATURE_MAX$year>=year_min & TEMPERATURE_MAX$year<=year_max

prec_mes <- PRECIPITATION[period,]
Tx_mes <- TEMPERATURE_MAX[period_temp,]
Tn_mes <- TEMPERATURE_MIN[period_temp,]
accepted <- array(TRUE,length(names(prec_mes)))
names(accepted) <- names(prec_mes)
for (it in names(prec_mes)) {
  acc <- TRUE
  acc <- (length(which(!is.na(Tx_mes[,it])))==length(Tx_mes[,it]))
  acc <- (length(which(!is.na(Tn_mes[,it])))==length(Tn_mes[,it])) & acc
  accepted[it] <- (length(which(!is.na(prec_mes[,it])))==length(prec_mes[,it])) & acc
}

valmin <- 1.0
prec_mes <- prec_mes[,accepted]

Tx_mes <- Tx_mes[,accepted]
Tn_mes <- Tn_mes[,accepted]
origin <- paste(year_min,1,1,sep="-")

prec_occurrence_mes <- prec_mes>=valmin
```

```

station <- names(prec_mes)[!(names(prec_mes) %in% c("day", "month", "year"))]
it <- station[2]
vect <- Tx_mes[,it]-Tn_mes[,it]
months <- factor(prec_mes$month)
model <- PrecipitationOccurrenceModel(x=prec_mes[,it],exogen=vect,monthly.factor=months)

probs <- predict(model)

nday <- 3.0
vect_new <- array(1.0,nday)
months_new <- array(1,nday)
row_test <- 2000:2007
newdata <- model$predictor[row_test,]
probs2 <- predict(model,newdata=newdata)

probs[row_test]==probs2
###

prec_occurrence_mes <- prec_mes>=valmin

station <- names(prec_mes)[!(names(prec_mes) %in% c("day", "month", "year"))]

station <- station[1:4] ## reduced the dataset!!!
Tx_mes <- Tx_mes[,station]
Tn_mes <- Tn_mes[,station]

prec_mes <- prec_mes[,station]
exogen <- Tx_mes-Tn_mes
months <- factor(prec_mes$month)

### Not Run
### Please uncomment the following lines to run them

model_multisite <- PrecipitationOccurrenceMultiSiteModel(x=prec_mes,
exogen=exogen,origin=origin,multisite_type="wilks")

model_multisite_logit <- PrecipitationOccurrenceMultiSiteModel(x=prec_mes,
exogen=exogen,origin=origin,multisite_type="logit")

probs_multimodel <- predict(model_multisite_logit)

```

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