Package ‘CommunityCorrelogram’

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Author J. Malia Andrus, Timothy Kuehlhorn, Luis F. Rodriguez, Angela D. Kent, and Julie L. Zilles

Maintainer J. Malia Andrus <jmaliaandrus@gmail.com>

Depends vegan, methods

Description The CommunityCorrelogram package is designed for the geostatistical analysis of ecological community datasets with either a spatial or temporal distance component.

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`CommunityCorrelogram-package` *Ecological Community Correlogram*

Description

The `CommunityCorrelogram` package is designed for the geostatistical analysis of ecological community datasets with either a spatial or temporal distance component.

Details

Package:	CommunityCorrelogram
Type:	Package
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The package includes functions for constructing correlogram structure functions using either the Mantel or ANOSIM statistics, for assisting in selection of an appropriate lag size, and for modeling correlogram significance plots to determine correlation range.

The `commcorrelogram()` package adds functionality over existing Mantel correlogram functions by allowing directional (anisotropic) restrictions in both the `xy` (surface) plane and the `z` (depth) plane, and allowing usage of temporal and spatial information in the same correlogram. It also contains an automatic modeling function that calculates the correlation distance of communities or other multidimensional datasets.

Author(s)

J. Malia Andrus, Timothy Kuehlhorn, Luis F. Rodriguez, Angela D. Kent, and Julie L. Zilles

Maintainer: J. Malia Andrus <jmaliaandrus@gmail.com>

References

See function documentation.

`commcorrelogram` *Community Correlogram*

Description

The function `commcorrelogram` computes community correlograms using either the multivariate metric ANOSIM R (Clarke, 1993) or the Mantel statistic (Mantel, 1967), and includes functionality for both directional analyses and combinations of temporal or spatial analyses or both. The Mantel correlogram was originally proposed by Sokal (1986) and Oden and Sokal (1986). The ANOSIM correlogram is suggested here.

Usage

```
commcorrelogram(sampleData,sampleTime=NULL,sampleLocation=NULL,
LocationNames=NULL,option=1,metric='anosim',lagNumber,lagSize,lagTol,
numTests=999,anisotropic=FALSE,azimuth,azimuthTol,bandwidth,dipAngle,dipTol,
dipBandwidth,distmeth='bray',mantmeth='spearman',adj='holm',prog=TRUE,
alternative='one.sided')
```

Arguments

`sampleData` A matrix or dataframe with samples as rows and species or populations as columns

`sampleTime` A numeric, date, or POSIX format vector of sample collection times for the objects in `sampleData` (used for temporal analyses only)

`sampleLocation` A matrix or dataframe of xyz, xy (surface) plane and the z (depth) plane, geographical coordinates for objects in `sampleData` (used for spatial analyses only)

`LocationNames` A character vector of location names for the objects in `sampleData` (used for temporal analyses grouped by location)

`option` A switch specifying type of correlogram to be determined (spatial, temporal, or a combintation of both). Options include: 1 = spatial analysis only (provide `sampleLocation`), 2 = temporal analysis only (provide `sampleTime`), 3 = spatial analysis grouped by sampling event (provide `sampleLocation` and `sampleTime`), 4 = temporal analysis grouped by sampling location (provide `sampleTime` and either `sampleLocation` or `LocationNames`). Default = 1.

`metric` A switch specifying statistical test for similarity to be applied. Options include: 'anosim' = ANOSIM Correlogram, 'mantel' = Mantel Correlogram. Default = 'anosim'.

`lagNumber` Number of distance (lag) classes for correlogram

`lagSize` Multiple for which the centers of distance (lag) classes are calculated

`lagTol` Lag tolerance. Default is half the width of each distance (lag) class.

`numTests` Number of permutation tests for significance testing. Default = 999.

`anisotropic` A switch specifying whether sample pairs are restricted by geographic separation angles. Default = F. The user is advised to consider whether anisotropic analsyses are appropriate for their dataset and specify a value for `anisotropic` accordingly.

`azimuth` Direction of sample restriction in the xy plane (degrees)

`azimuthTol` Tolerance of sample restriction angle in the xy plane (degrees)

`bandwidth`	Maximum perpendicular distance from vector of sample restriction angle in the z direction
`dipAngle`	Direction of sample restriction in the z (depth) direction (degrees)
`dipTol`	Tolerance of sample restriction angle in the z direction (degrees)
`dipBandwidth`	Maximum perpendicular distance from vector of sample restriction angle in the z direction
`distmeth`	A switch specifying method to be applied for calculation of ecological distances between `sampleData`. A complete listing of available options are described in `vegdist`. Default = 'bray'.
`mantmeth`	A switch specifying method to be applied for calculation of the Mantel statistic between ecological and geographical or temporal distance matrices. Default = 'spearman' for Spearman rank correlation. Other options are 'pearson' and 'kendall', as described in `cor`.
`adj`	A switch specifying method for adjustment of significance values for multiple comparison tests to be applied. Default = 'holm'. Other options are as in described in `p.adjust`.
`prog`	A switch specifying whether to adjust significance progressively as described in Legendre and Legendre (1998, p. 721). Significance for distance class k = correction for k multiple tests. Default = T.
`alternative`	A switch specifying alternative hypothesis for statistical tests to be applied. Options include: 'one.sided' = statistic <= 0, 'two.sided' = statistic = 0. Default = 'one.sided'.

Details

Mantel correlograms, a form of geostatistical structure function, have often been used in ecological analyses to evaluate the spatial variation of ecological communities or other multidimensional datasets (Mantel, 1967; Oden and Sokal, 1986; Sokal, 1986; Legendre and Legendre, 2012). The correlogram bins sample pairs by their spatial or temporal separation distance and then plots the average multidimensional similarity between pairs versus their (binned) separation distance; the approach tests whether pairs of samples that are separated by a particular distance are more similar than those that are separated by a different distance. By not including lesser distances in a distance class, recurring or oscillating patterns can be detected as well as gradients.

Basic Mantel correlograms are implemented in both the `vegan` (Oksanen et al., 2012) and `ecodist` (Goslee and Urban, 2007) packages; however, anisotropy, or directional differences in spatial structure, is frequently encountered in geostatistical analyses. The `commcorrelogram()` function, unlike other implementations, includes the ability to impose directional restrictions on the distance classes, facilitating identification and characterization of spatial patterns(Andrus et al. 2013). The current implementation further allows the integration of temporal and spatial data; strictly temporal or spatial correlograms can be performed, or alternatively temporal correlograms holding spatial locations constant or spatial correlograms holding sample times constant are possible. This functionality allows multiple perspectives of analysis of data that has been collected in several locations over time.

The distance classes are specified by the parameters lag size (h, the interval between distance classes) and lag tolerance (width of the distance classes) and must be optimized for each dataset (see `lagSelect`). To include all samples in one distance class the lag tolerance is set to half the lag size. Directional parameters are standard geostatistical terms, for example as used in the `gamv` program of the FORTRAN geostatistics package GS-Lib (Deutsch and Journel, 1998). The azimuth is the direction of the analysis along a horizontal plane, while the allowed variation in this direction is the azimuth tolerance, and the allowed perpendicular distance from the azimuth is the bandwidth. Similarly, parameters related to deflection from this surface in the depth direction (dip angle, dip tolerance, and dip bandwidth) can also be defined.

Additionally, the function also allows selection of either the ANOSIM R statistic (Clarke and Green, 1988; Clarke, 1993) or the Mantel statistic R_M (Mantel, 1967) as measures of similarity within the correlogram. In univariate analyses, various statistics have been developed to quantify autocorrelation: e.g. Moran's I (Moran, 1950), Geary's C (1954). The ANOSIM statistic is commonly used in microbial ecology to test differences in community between factor groups, and therefore may be more accessible for microbial ecologists performing spatial or temporal community analyses. It is a nonparametric statistic based on the ranks of similarities between sample pairs. The similarity metric used to calculate similarity is user-specified.

The implementation of ANOSIM in a correlogram is an adaptation of the original statistic for pairs of samples separated by a particular distance rather than for membership in a particular group. The statistic is calculated for a specific distance class h:

$$R(h) = \frac{r_b(h) - r_w(h)}{\frac{1}{4}n(n-1)}$$

where $r_b(h)$ is the mean rank of similarities for sample pairs between groups (with a separation distance not equal to h), $r_w(h)$ is the mean rank of similarities for sample pairs within groups (separated by a distance of h), and n is the total number of samples.

Legendre and Legendre (2012) advise adjusting the p-values for each distance class in a multidimensional correlogram for multiple comparison. This function allows the specification of a particular multiple comparison adjustment via `p.adjust` and whether the comparison should be adjusted progressively or uniformly. Furthermore, the p-value can be calculated based on whether a one- or two-tailed test is desired. For a two-tailed test, the p-value reflects the probability that the Mantel R_M or ANOSIM R statistic is zero, or in other words, there is no difference in similarity between sample pairs having a particular separation distance and those that do not.

Value

Returns an object of class `community.correlogram`, which is a `dataframe` consisting of:

`lag.distance`	The average lag distance separating pairs in the lag class
`Num.Pairs`	The number of pairs in the lag class
`statistic`	The value of the statistic (Mantel or ANOSIM) for the lag class
`significance`	The p-value (adjusted if required) of the statistic

Author(s)

J. Malia Andrus, Timothy Kuehlhorn, Luis F. Rodriguez, Angela D. Kent, and Julie L. Zilles

Maintainer: J. Malia Andrus <jmaliaandrus@gmail.com>

References

Andrus, J. M., Matthew D. Porter, Luis F. Rodriguez, Timothy Kuehlhorn, R. A. C. Cooke, Yuanhui Zhang, Angela D. Kent, and Julie L. Zilles. 2013. "Spatial Variation in the Bacterial and Denitrifying Bacterial Community in a Biofilter Treating Subsurface Agricultural Drainage." Microbial Ecology. DOI 10.1007/s00248-013-0286-0.

Clarke KR, Green RH (1988) Statistical design and analysis for a biological effects study. Mar Ecol-Prog Ser 46 (1-3):213-226.

Clarke KR (1993) Nonparametric multivariate analyses of changes in community structure. Aust J Ecol 18 (1):117-143.

Deutsch, C. V. and A. G. Journel. 1998. GSLIB geostatistical software library and user's guide. Oxford: Oxford University Press.

Geary, R.C. (1954). "The Contiguity Ratio and Statistical Mapping". The Incorporated Statistician 5 (3): 115-145.

Goslee, S.C. and Urban, D.L. 2007. The ecodist package for dissimilarity-based analysis of ecological data. Journal of Statistical Software 22(7): 1-19.

Legendre, P., and L. Legendre. 1998. Numerical Ecology. 2nd English Edition. Elsevier Science: Amsterdam.

Legendre, P., and L. Legendre. 2012. Numerical Ecology. 3rd English Edition. Elsevier Science: Amsterdam.

Mantel, N. 1967. The detection of disease clustering and a generalized regression approach. Cancer Res. 27: 209-220.

Moran, P.A.P.(1950). Notes on Continuous Stochastic Phenomena. Biometrika 37 (1): 17-23.

Oden, N. L. and R. R. Sokal. 1986. Directional autocorrelation: an extension of spatial correlograms to two dimensions. Syst. Zool. 35: 608-617.

Oksanen, J., F. G. Blanchet, R. Kindt, P. Legendre, P. R. Minchin, R. B. O'Hara, G. L. Simpson, P. Solymos, M. Henry, H. Stevens and H. Wagner (2012). vegan: Community Ecology Package. R package version 2.0-4. http://CRAN.R-project.org/package=vegan

Sokal, R. R. 1986. Spatial data analysis and historical processes. 29-43 in: E. Diday et al. [eds.] Data analysis and informatics, IV. North-Holland, Amsterdam.

See Also

`mod.commcorrelogram`

`lagSelect`

Examples

```
#spatial community ANOSIM correlogram
data(mite)
data(mite.xy)
commcorrelogram(sampleData=mite,sampleLocation=cbind(mite.xy,z=0)
,lagSize=0.3,lagNumber=17,lagTol=0.15,option=1,numTests=5)

## Not run:
  #spatial community Mantel correlogram
```

```
data(mite)
data(mite.xy)
commcorrelogram(sampleData=mite,sampleLocation=cbind(mite.xy,z=0)
,lagSize=0.3,lagNumber=17,lagTol=0.15,option=1,metric="mantel"
,mantmeth="spearman",numTests=9)

#anisotropic community correlograms
commcorrelogram(sampleData=mite,sampleLocation=cbind(mite.xy,z=0)
,lagSize=0.3,lagNumber=8,lagTol=0.15,option=1,anisotropic=TRUE
,azimuth=0,azimuthTol=15,bandwidth=2,numTests=9,dipAngle=0
,dipTol=90,dipBandwidth=1)

commcorrelogram(sampleData=mite,sampleLocation=cbind(mite.xy,z=0)
,lagSize=0.5,lagNumber=10,lagTol=0.25,option=1,anisotropic=TRUE
,azimuth=90,azimuthTol=15,bandwidth=2,numTests=9,dipAngle=0
,dipTol=90,dipBandwidth=1)

commcorrelogram(sampleData=mite,sampleLocation=cbind(mite.xy,z=0)
,lagSize=0.5,lagNumber=10,lagTol=0.25,option=1,anisotropic=TRUE
,azimuth=45,azimuthTol=15,bandwidth=2,numTests=9,dipAngle=0
,dipTol=90,dipBandwidth=1)

#temporal community correlogram
data(pyrifos)
pyrifos.levels<-data.frame(ditch=gl(12,1,length=132),
dose=factor(rep(c(0.1, 0, 0, 0.9, 0, 44, 6, 0.1, 44, 0.9, 0, 6),11)),
    week=as.numeric(as.character(gl(11, 12,
    labels=c(-4, -1, 0.1, 1, 2, 4, 8, 12, 15, 19, 24)))))
commcorrelogram(sampleData=pyrifos,sampleTime=pyrifos.levels$week,
option=2,lagSize=3,lagTol=1.5,numTests=9,lagNumber=10)

#temporal community correlogram holding location constant
commcorrelogram(sampleData=pyrifos,sampleTime=pyrifos.levels$week,
LocationNames=pyrifos.levels$ditch,option=4,lagSize=3,lagTol=1.5,
numTests=9,lagNumber=10)

## End(Not run)
```

---

commcorrelogram-class *Class* "community.correlogram"

Description

The `community.correlogram` class is designed for the geostatistical analysis of ecological community datasets with either a spatial or temporal distance component.

Objects from the Class

Objects can be created by calls of the form `new("commcorrelogram", ...)`, which will be useful for subsequent calls to `mod.commcorrelogram` or `plot.commcorrelogram`.

Slots

`community.correlogram`: Object of class "`data.frame`" consisting of:

- **lag.distance** The average lag distance separating pairs in the lag class
- **Num.Pairs** The number of pairs in the lag class
- **statistic** The value of the statistic (Mantel or ANOSIM) for the lag class
- **significance** The p-value (adjusted if required) of the statistic

Methods

mod `signature(object = "commcorrelogram")`: ... calls `mod.commcorrelogram` and automatically fits a Gaussian curve to the significance plot of a commcorrelogram object and calculates the correlation range of the data.

plot `signature(x = "commcorrelogram", y = "missing")`: ... calls `plot.commcorrelogram` for custom visual displays of correlograms allowing visualization of spatial correlation within `community.correlogram` objects.

Author(s)

J. Malia Andrus, Timothy Kuehlhorn, Luis F. Rodriguez, Angela D. Kent, and Julie L. Zilles

Maintainer: J. Malia Andrus <jmaliaandrus@gmail.com>

Examples

```
showClass("commcorrelogram")
```

`lagSelect` *Lag Selection*

Description

Function `lagSelect` provides multiple community correlograms of varying lag sizes to assist in optimizing lag size and number.

Usage

```
lagSelect(sampleData,sampleLocation=NULL,sampleTime = NULL,LocationNames=NULL,
lagmin,lagmax,by,option=1,numTests=99,plot=T,anisotropic=F,...)
```

Arguments

`sampleData`	A matrix or dataframe with samples as rows and species or populations as columns
`sampleLocation`	A matrix or dataframe of xyz, xy (surface) plane and the z (depth) plane, geographical coordinates for objects in `sampleData` (used for spatial analyses only)
`sampleTime`	A numeric, date, or POSIX format vector of sample collection times for the objects in `sampleData` (used for temporal analyses only)

`LocationNames`	A character vector of location names for the objects in `sampleData` (used for temporal analyses grouped by location)
`lagmin`	Minimum lag size to compute in the units of distance (for options 1 and 3) or time (for options 2 and 4)
`lagmax`	Maximum lag size to compute in the units of distance (for options 1 and 3) or time (for options 2 and 4)
`by`	Number to increment tested lag sizes by
`option`	A switch specifying type of correlogram to be determined (spatial, temporal, or a combination of both). Options include: 1 = spatial analysis only (provide `sampleLocation`), 2 = temporal analysis only (provide `sampleTime`), 3 = spatial analysis grouped by sampling event (provide `sampleLocation` and `sampleTime`), 4 = temporal analysis grouped by sampling location (provide `sampleTime` and either `sampleLocation` or `LocationNames`). Default = 1.
`numTests`	Number of permutations used to calculate significance. Default = 99.
`plot`	A switch specifying whether to plot the `community.correlogram` calculated from each lag size. Default = T.
`anisotropic`	A switch specifying whether an anisotropic analysis should be performed. Default = F. The user is advised to consider whether an anisotropic analsysis is appropriate for their particular dataset and specify a value for `anisotropic` accordingly.
`...`	Other parameters passed to `commcorrelogram`

Details

Optimization of lag size is critical for geostatistical analyses (Goovaerts, 1997). This function provides correlograms over a range of lag distances within user specified minimum and maximum distances, calculated using `commcorrelogram()`. Some general rules of thumb exist for selection of lag size and number (Journel and Huijbregts, 1978; Legendre and Fortin, 1989):

1. The lag distance must be larger than the smallest sampling distance.
2. A minimum of 30 sample pairs per lag distance is recommended.
3. The maximum distance class should be no more than 2/3 the total sampling site distance.

It is helpful when using this function to use a small value for numTests, to improve speed and reduce computational intensity.

Value

Returns a list of objects of class `community.correlogram`, each with different lag size used to compute them.

Plots of community correlogram metrics and significance values are created for each lag size tested when plot = T.

Author(s)

J. Malia Andrus, Timothy Kuehlhorn, Luis F. Rodriguez, Angela D. Kent, and Julie L. Zilles

Maintainer: J. Malia Andrus <jmaliaandrus@gmail.com>

References

Goovaerts, P. 1997. Geostatistics for natural resources evaluation. Oxford, England: Oxford University Press.

Journel, A. G. and C. J. Huijbregts. 1978. Mining Geostatistics. San Diego, CA: Academic Press.

Legendre, P. and M. J. Fortin. 1989. Spatial Pattern and Ecological Analysis. Vegetatio 80(2): 107-138.

See Also

commcorrelogram

Examples

```
  ## Not run:
    #spatial lag selection
      data(mite)
      data(mite.xy)
      lagSelect(sampleData=mite,sampleLocation=cbind(mite.xy,z=0),lagmin=0.1
      ,lagmax=1,by=0.1,numTests=9)

      #temporal lag selection
      data(pyrifos)
      pyrifos.levels<-data.frame(ditch=gl(12,1,length=132),
      dose=factor(rep(c(0.1, 0, 0, 0.9, 0, 44, 6, 0.1, 44, 0.9, 0, 6),11)),
          week= as.numeric(as.character(gl(11, 12,
          labels=c(-4, -1, 0.1, 1, 2, 4, 8, 12, 15, 19, 24)))))
      lagSelect(sampleData=pyrifos,sampleTime=pyrifos.levels$week,
      option=2,lagmin=1,lagmax=6,by=1,numTests=9)

## End(Not run)
```

---

mod.commcorrelogram *Community Correlogram Model*

Description

Function mod.commcorrelogram automatically fits a Gaussian curve to the significance plot of a commcorrelogram object and calculates the correlation range of the data.

Usage

```
mod.commcorrelogram(object,Ch=1,Cc=5,Cw=0.01,plot=T,alpha=0.05,
alternative='one.tailed',pw=5,lgpos='topleft',...)
```

Arguments

object	A community.correlogram object
Ch	An initial guess for the asymptotic maximum significance. Default = 1. The user is advised to consider values for Ch appropriate for their particular dataset and specify values accordingly.
Cc	An initial guess for the center of the Gaussian curve. Default = 5. The user is advised to consider values for Cc appropriate for their particular dataset and specify values accordingly.
Cw	An initial guess for the Gaussian curve incline. Default = 0.01. The user is advised to consider values for Cw appropriate for their particular dataset and specify values accordingly.
plot	A switch specifying whether to plot results. Default = T.
alpha	The level of Type I error to be applied to the analysis. Default = 0.05.
alternative	A switch specifying alternative hypothesis for statistical tests to be applied. Options include: 'one.tailed' = statistic <= 0, 'two.tailed' = statistic = 0. Default = 'one.sided'. Note: This selection must match the alternative hypothesis used in the calculation of link{commcorrelogram}.
pw	Weight given to significance points in proximity of alpha. The user is advised to consider values for pw appropriate for their particular dataset and specify values accordingly.
lgpos	A switch specify position of the legend, and passed to legend. Default = 'topleft'.
...	Other parameters passed to commcorrelogram

Details

One of the main purposes of constructing a correlogram is to determine the maximum distance at which the samples are statistically similar, or range of correlation. Typically, the range of correlation of a multivariate correlogram is determined by finding on the primary plot the class for which the statistic is no longer significant. However, depending on the lag size and tolerance of the correlogram, this may not be a very precise figure. Depending on the spatial (or temporal) structure reflected in the plot, or the number of pairs in the deciding lag class, the figure may not be very accurate, either.

The approach developed here is to instead plot the significance values of the correlogram in a separate plot and model this plot to determine the point at which the curve is equal to a chosen Type I error rate (alpha, typically 0.05). In univariate geostatistics, the range of correlation is typically found by modeling the semivariogram structure function (Goovaerts, 1997). To model the correlogram significance plot, we developed a Gaussian model similar to that used to model univariate semivariograms:

$$y^s(h) = C_h(1 - e^{C_w(h-C_C)^2})$$

where C_h is the curve height, C_w the curve width/steepness, C_c the curve center, and h the lag separation.

The `mod.commcorrelogram()` function automatically fits this Gaussian curve to `commcorrelogram` objects using the `nlminb` optimization function and calculates the correlation distance (where the resulting curve equals `alpha`) using the `uniroot` function. The function allows the user to provide initial guesses for each parameter and also allows the user to adjust the weight of points that are closest to the `alpha` level in the optimization routine. This enhances the fit of the curve around the `alpha` line. In the case where a two-tailed correlogram has been calculated, the ranges at which the modeled curve crosses the `alpha`/2 line (where samples are no longer statistical similar) and where it crosses the 1-`alpha`/2 line (where samples become statistically different), called here the "outer range" are reported.

Value

Returns a list of objects of class community.correlogram, each with different lag size used to compute them.

`model.coefficients`
: A vector of fitted values for C_h, C_c, and C_w

`empirical`
: The original empirical community correlogram used for modeling

`predicted`
: A dataframe of predicted values against lag separation distance for use in external plotting or other functions

`range`
: The correlation range (one.tailed analyses use model = `alpha`, two.tailed analyses use model=`alpha`/2)

`outer.range`
: The outer correlation range for two.tailed analyses (model=1-`alpha`/2)

Plots of community correlogram metrics, significance values, modeled significance curve and the correlation range are created when plot=TRUE.

Author(s)

J. Malia Andrus, Timothy Kuehlhorn, Luis F. Rodriguez, Angela D. Kent, and Julie L. Zilles

Maintainer: J. Malia Andrus <jmaliaandrus@gmail.com>

References

Goovaerts, P. 1997. Geostatistics for natural resources evaluation. Oxford, England: Oxford University Press.

See Also

`commcorrelogram`

Examples

```
## Not run:
  data(mite)
    data(mite.xy)
    mite.commcorr <-commcorrelogram(sampleData=mite,
        sampleLocation=cbind(mite.xy,z=0),lagSize=1,lagNumber=7,
        lagTol=0.5,option=1,numTests=9)
```

```
        mod (mite.commcorr,Ch=1,Cc=2.5,Cw=0.8,pw=3)

## End(Not run)
```

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