Package 'CircE'

February 19, 2015

Version 1.1

Date 2014/7/8

Title Circumplex models Estimation

Author Michele Grassi <grassi.mic@gmail.com>

Maintainer Michele Grassi <grassi.mic@gmail.com>

Depends R (>= 1.6.0), stats

Description This package contains functions for fitting circumplex structural models for correlation matrices (with negative correlation) by the method of maximum likelihood.

License GPL (>= 2)

LazyLoad true

NeedsCompilation no

Repository CRAN

Date/Publication 2014-09-09 14:12:27

R topics documented:

CircE-package *Circumplex models Estimation*

Description

An R package for circumplex models estimation. This package contains functions for fitting circumplex structural models for correlation matrices (with negative correlation) by the method of maximum likelihood.

Details

Package:	CircE
Type:	Package
Version:	1.0
Date:	2014/3/4
License:	GPL (>= 2)

Author(s)

Michele Grassi <grassi.mic@gmail.com>

Block *Intercorrelation of Emotions in a Female Sample (N=48)*

Description

The Osgood's "semantic differential" form was administered to 40 male and 48 female college students in an undergraduate psychology course. Fifteen emotions, selected a priori but with the intention of comprehensive coverage of the affective sphere, were used as the concepts to be defined. Each concept was evaluated in terms of twenty connotative 7-point scales. The intercorrelations matrix based upon the female sample is given in this object.

Usage

```
data(Block)
```

Source

Block, J. (1957). Studies in the phenomenology of emotions. *Journal of Abnormal and Social Psychology*, 54, 358-363.

Examples

```
data(Block)

Block

block.names=colnames(Block)
block.names

## Not run:
Block.m.1<-CircE.BFGS(R=Block,v.names=block.names,m=1,N=48,start.values="IFA")
# You will get the following warnings:
# WARNING!
# INPUT COVARIANCE/CORRELATION MATRIX IS NOT POSITIVE DEFINITE.
# STARTING VALUES CANNOT BE COMPUTED USING 'IFA': SET start.values='PFA'
# Error in ifa(R, k) :
# Make sure the listwise, not pairwise, missing data treatment has been selected
# in computing the input matrix
#
# The error message reported by CircE highlights that the problem in fitting a CSPMF
# to Block's data occurs at the early stage of starting values computation.
# CircE offers a way to sidestep this problem without actually trying to discern its cause:
# In fact, at this stage, the IFA cannot be carried out since the inverse of the
# non-positive definite Block's matrix has negative values
# on the diagonal (Joreskog, 1969, p. 54):


diag(solve(Block))

# To overcome this problem, CircE offers an alternative ways to obtain initial
# parameters estimation, based on Principal Factor Analysis (PFA):

Block.m.1<-CircE.BFGS(R=Block,v.names=block.names,m=1,N=48,start.values="PFA")

## End(Not run)
```

---

bound.assign *Bound assignation for polar angles*

Description

This function allows to quickly assign bound on polar angles estimates.

Usage

```
bound.assign(sc.names,v.names,lower,upper)
```

Arguments

sc.names	character string containing the names of the variables to be matched in the given character vector v.names. It must contains the patterns that identify the variables belongingness in the variable (or items) names.
v.names	a character vector where matches are sought (e.g. the variables (or items) names).
lower	a vector of lower bounds.
upper	a vector of upper bounds.

Author(s)

Michele Grassi <grassi.mic@gmail.com>

Examples

```
data(SELF5)
v.names=names(SELF5)
v.names

sc.names=c("LM","NO","PA","BC","DE","FG","HI","JK")
lower<-c(-22.5,292.5,247.5,202.5,157.5,112.5,67.5,22.5)
upper<-c(22.5,337.5,292.5,247.5,202.5,157.5,112.5,67.5)
B<-bound.assign(sc.names=sc.names,v.names=v.names,lower=lower,upper=upper)

B$upper


B$lower

# Each one of the 48 items (v.names) is provided with an upper and lower bound:

bounds<-data.frame(v.names,B$upper,B$lower)

bounds[order(B$upper),]
```

---

char.assign *Points character and color assignation for CircE.Plot*

Description

This function allows to quickly assign different point characters and color to the different variables. It is especially useful in working with raw items whose names are usually composed by a serial number and the name of the main variable to which they refer to.

Usage

```
char.assign(sc.names,v.names,point.char,bg.point)
```

Arguments

sc.names	character string containing the names of the variables to be matched in the given character vector v.names. It must contains the patterns that identify the variables belongingness in the variable (or items) names.
v.names	a character vector where matches are sought (e.g. the variables (or items) names).
point.char	points character, i.e., symbol to use for each variable.
bg.point	background (fill) color for the open plot symbols given by pch=21:25.

Details

The pattern matching between the character string given in sc.names and the v.names is based on grep function.

Author(s)

Michele Grassi <grassi.mic@gmail.com>

Examples

```
library(CircE)
data(SELF5)
v.names<-names(SELF5)
v.names

RS5<-cor(SELF5,use="pairwise.complete.obs")
RS5<-round(RS5,3)
 ## Not run:
# The "convergence to a solution" requires more than 200 iterations (e.g., set iterlim=250).
# This is long-running test made optional for checking.
Child<-CircE.BFGS(R=RS5,v.names=v.names,m=3,N=286,equal.com=FALSE,equal.ang=FALSE,
                  mcsc="unconstrained",iterlim = 250,factr=1e10)

# The features of\code{char.assign} can be effectively highlighted limiting the number
# of iterations allowed (e.g., set iterlim=5). This option makes the example faster.
Child<-CircE.BFGS(R=RS5,v.names=v.names,m=3,N=286,equal.com=FALSE,equal.ang=FALSE,
                  mcsc="unconstrained",iterlim = 5,factr=1e10)


## End(Not run)
# To simplify the assignation of color and character type of each point on the graph,
# which are required as arguments by the function CircE.Plot(),
# in the case of a large number of items, the function char.assign() can be used as follows:
# Supposing that the items are tagged with a reference to the relative scale (e.g., v.names),
# it is sufficient to create a string with scale names ('sc.names'),

sc.names=c("LM","NO","PA","BC","DE","FG","HI","JK")

# a vector of the same length containing the point characters ('point.char'),
```

```
point.char=c(21,23,16,17,25,24,8,3)

#  and a vector of colors name for filling-in the points ('bg.point');

bg.point=c("white","gray40","black","black","gray80","gray60","black","black")

# The function char.assign() matches scale names with the item names (the vector 'v.names')
# and assigns appropriate characters and colors automatically.
# The result is an R object ('A') which contains two vectors of the same length of variable names
# that will be passed to CircE.Plot().

A<-char.assign(sc.names=sc.names, v.names=v.names, point.char=point.char, bg.point=bg.point)
A$pchar

A$bg.points

## Not run:
CircE.Plot(Child,pchar=A$pchar,bg.points=A$bg.points,big.points=60,big.labels=40,
           bg.plot="white",col.text="black",twodim=FALSE,labels=FALSE)

## End(Not run)

char<-data.frame(v.names,A$pchar,A$bg.points)
char[order(A$pchar),]
```

CircE.BFGS *Circumplex models estimation*

Description

This function fits circumplex models for correlation matrices as described in Browne (1992). Results are convergent with those obtained using CIRCUM program wrote by Michael W. Browne and Stephen H.C. Du Toit (1992), available for download at this address http://faculty.psy.ohio-state.edu/browne/software.php.

Usage

```
CircE.BFGS(R, v.names, m, N, r = 1, equal.com = FALSE, equal.ang = FALSE,
         mcsc = "unconstrained", start.values="IFA",ci.level=0.95,factr = 1e+09,
           pgtol = 0, lmm = NULL, iterlim = 250, upper = NULL, lower = NULL,
           print.level = 1, file = NULL, title = "Circumplex Estimation",
           try.refit.BFGS=FALSE)
```

Arguments

R	input covariance/correlation matrix. If the matrix is obtained trough cov or cor, the precision to be used (decimal places) must be specified with round.

v.names	a string that contains the name of the variable used in R.
m	numbers of betas to use in the Fourier correlation function.
N	number of observation.
r	the reference variable in the correlation matrix. This variable will be positioned at 0 degree.
equal.com	logical: does the communality (radius length) for each variable have to been considered as equal? Default equal.com=FALSE.
equal.ang	logical: does the circular position of the variables have to been considered as equal spaced? Default equal.ang=FALSE.
mcsc	minimum common score correlation value: "unconstrained" (default), "-1" or "0".
start.values	if start.values="IFA" (default), initial estimates are provided by the factor analysis method described in Browne (1992; section 6.7) and based on Image Factor Analysis (IFA). When the input covariance/correlation matrix is not positive definite, the IFA cannot be carried out; in this case the Principal Factor Analysis (PFA) supply likely starting values (start.values="IFA").
ci.level	level for confidence interval for the parameter estimates (default is .95).
factr	controls the convergence of the "L-BFGS-B" method. Convergence occurs when the reduction in the objective is within this factor of the machine tolerance. Default is 1e09, that is a tolerance of about 2e-07.
pgtol	helps control the convergence of the "L-BFGS-B" method. It is a tolerance on the projected gradient in the current search direction. This defaults to zero, when the check is suppressed.
lmm	is an integer giving the number of BFGS updates retained in the "L-BFGS-B" method. It defaults to number of free parameters estimated.
iterlim	maximum number of iterations.
upper,lower	Bounds on the variables for the "L-BFGS-B" method. See bound.assign
print.level	Integer. Higher values may produce more tracing information on the progress of the optimization (print.level=0 no information is generated,print.level=1 print F value at every iterations, print.level=3 print F and also $\|\|projg\|\|$).
file	a connection or a character string naming the file to write to, or NULL (default) for do not send R output to a file.
title	title for the output (for identification purpose).
try.refit.BFGS	if TRUE, attempt to refit the model removing default box constraints on z,v, and a parameters, if L-BFGS-B fails to converge.

Details

Optimization is based on L-BFGS-B algorithm. See optim for further details.

Value

AGFI	adjusted goodness-of-fit index
AIC	Akaike Information Criterion
BCI	ECVI- expected cross-validation index
BIC	Schwarz's Bayesian Information Criterion
CAIC	Bozdogans's Consistent AIC
CFI	Bentler CFI
CNI	Hoelter's critical N (CN) index
Cs	reproduced covariance matrix
Fzero	population discrepancy function value; point estimate
Fzero.L	population discrepancy function value; lower 90% confidence limit
Fzero.U	population discrepancy function value; upper 90% confidence limit
GFI	goodness-of-fit index
MCSC	minimum common score correlation
NFI	Bentler-Bonnett NFI
NNFI	Tucker-Lewis TLI (or NNFI)
Pc	reproduced common score correlation matrix
R	observed covariance/correlation matrix
RMSEA	root mean square error of approximation; point estimate
RMSEA.L	root mean square error of approximation; lower 90% confidence limit
RMSEA.U	root mean square error of approximation; upper 90% confidence limit
S	reproduced correlation matrix
SRMR	standardized root mean squared residual
beta	Fourier correlation function's betas
chisq	the chisquare test statistic for the model
chisqNull	the chisquare value associated with a null model in which all of the observed variables are uncorrelated
coeff	data frame containing parameters value and their standard errors after convergence
communality	communality values for each observed variable
communality.index	communality index values for each observed variable
criterion	sample discrepancy function value
d	degree of freedom of the model
dfNull	degree of freedom of the Null model
equal.ang	if TRUE, the variables are constrained to be equally distributed on the circumference. The default is FALSE
equal.com	if TRUE, the communality indices are constrained to be equal. The default is FALSE

m	number of free parameters in the Fourier correlation function
n	number of observations
polar.angles	data frame containing the estimated polar angles, the lower (L) and the upper (U) limits of an approximate 95% confidence interval for each variable
q	effective number of parameters
residuals	The residuals are defined as R - S (or R- Cs), where R is the sample correlation (or sample covariance) matrix of the observed variables and S (or Cs) is the model-reproduced correlation (or covariance) matrix
standardized.residuals	The standardized residual covariance for a pair of variables divides the residual covariance by the product of the sample standard deviations of the two variables
v.names	variable names

Author(s)

Michele Grassi <grassi.mic@gmail.com>

References

Grassi, M., Luccio, R., \& Di Blas, L. (2010) CircE: An R implementation of Browne's circular stochastic process model. *Behavior Research Methods*, 42(1), pp. 55-73.
Browne, M. W. (1992) Circumplex models for correlation matrices. *Psychometrika*, 57, pp. 469-497.
Browne, M. W., \& Du Toit, S. H. C. (1992) Automated fitting of nonstandard models. *Multivariate Behavioral Research*, 27, pp. 269-300.

Examples

```
#______ Vocational Interests Scale: Sample Correlation Matrix. N=175 _____

R.vocational=matrix(c(
1,0,0,0,0,0,0,
0.654,1,0,0,0,0,0,
0.453,0.644,1,0,0,0,0,
0.251,0.440,0.757,1,0,0,0,
0.122,0.158,0.551,0.493,1,0,0,
0.218,0.210,0.570,0.463,0.754,1,0,
0.496,0.264,0.366,0.202,0.471,0.650,1
),7,7,byrow=TRUE)
R=R.vocational+t(R.vocational)-diag(diag(R.vocational))


v.names=c("Health","Science","Technology","Trades","Business Operations",
          "Business Contact","Social")
dimnames(R)=list(v.names,v.names)
```

```
model=CircE.BFGS(R,v.names,m=3,N=175,r=1)


#______ Some useful residual matrix with residual.CircE() function...

residual.CircE(model,digits=3)

#______ Save output on .txt file at the current directory ____________________
# get current directory
getwd()

# save the example.txt file at the current directory with
## Not run:
CircE.BFGS(R,v.names,m=3,N=175,r=1,file="example CircE.BFGS.txt")

## End(Not run)
```

`CircE.Plot` *Circumplex Estimates Plot*

Description

`CircE.Plot` produces the graphical representations of the estimated circular position of the variables and the Fourier correlation function. The function uses `dev.new` to create two different devices preserving an appropriate aspect ratio.

Usage

```
CircE.Plot(object, pchar = NULL, bg.points = "red", ef = 0.4, big.points = 10,
   big.labels = 10, bg.plot = "gray80", col.axis = "black", color = "black",
   col.text = "white",twodim=TRUE,bound=TRUE,labels=TRUE,reverse=FALSE)
```

Arguments

`object`	a circumplex model produced by `CircE.BFGS`.
`pchar`	plotting character, i.e., symbol to use. It can be either a single value or a vector of length equal to numbers of variables used in correlation matrix. For further details see `?par`.
`bg.points`	background color for the symbols selected with `pchar`. Either a single value or a vector of color.
`ef`	"explosion factor". It specifies the distances at which the name of the variables are drawn around the circumference. Default to 0.4 (if negative labels are drawn inside the circumference).
`big.points, big.labels`	numerical values giving the amount by which plotting labels and symbols should be magnified relative to the default (`cex` = 1/(number of observed variables)).

bg.plot	background color of the plot region.
col.axis	the color to be used for axis annotation, axis line and labels.
color	the color to be used for plot lines and symbols foreground.
col.text	the color to be used for plot texts.
twodim	logical. If FALSE (default), two reference axes are drawn.
bound	logical. If arguments upper and lower in object are not NULL, the bound lines are drawn on the circumference. Default is TRUE.
labels	logical. If TRUE (default), variable labels are reported in the plot.
reverse	logical. If TRUE, plot the figure using the 360-angular positions (just reversing the circular order).

Author(s)

Michele Grassi <grassi.mic@gmail.com>

See Also

See Also plot, points, par.

Examples

```
#______ Vocational Interests Scale: Sample Correlation Matrix. N=175 _____

R.vocational=matrix(c(
1,0,0,0,0,0,0,
0.654,1,0,0,0,0,0,
0.453,0.644,1,0,0,0,0,
0.251,0.440,0.757,1,0,0,0,
0.122,0.158,0.551,0.493,1,0,0,
0.218,0.210,0.570,0.463,0.754,1,0,
0.496,0.264,0.366,0.202,0.471,0.650,1
),7,7,byrow=TRUE)
R=R.vocational+t(R.vocational)-diag(diag(R.vocational))

v.names=c("Health","Science","Technology","Trades","Business Operations",
          "Business Contact","Social")
dimnames(R)=list(v.names,v.names)

## Not run:

model=CircE.BFGS(R,v.names,m=3,N=175,r=1)

CircE.Plot(object=model, pchar = 24, bg.points = "transparent", ef = -0.4,
           big.points = 15, big.labels=6, bg.plot = "white", col.axis = "black",
           color = "black", col.text = "black",
           twodim=FALSE,bound=TRUE,labels=TRUE)
```

```
## End(Not run)



#_____________ Block's correlation matrix. N=48 ________

data(Block)
block.names=colnames(Block)

## Not run:

Block.m.1<-CircE.BFGS(R=Block,v.names=block.names,m=1,N=48,start.values="PFA")

CircE.Plot(object=Block.m.1, pchar = 24, bg.points = "gray", ef = -0.4,
           big.points = 25, big.labels=15, bg.plot = "orange", col.axis = "blue",
           color = "black", col.text = "red",
           twodim=FALSE,bound=TRUE,labels=TRUE)


CircE.Plot(object=Block.m.1, pchar = 21, bg.points = "red", ef = -0.4,
           big.points = 25, big.labels=15, bg.plot = "white", col.axis = "black",
           color = "black", col.text = "white",
           twodim=FALSE,bound=TRUE,labels=TRUE)


CircE.Plot(object=Block.m.1, pchar = 21, bg.points = "red", ef = -0.2,
           big.points = 25, big.labels=15, bg.plot = "black", col.axis = "green",
           color = "white", col.text = "yellow",
           twodim=FALSE,bound=TRUE,labels=TRUE)

## End(Not run)
```

`residual.CircE` *Sample, reproduced observed scores, reproduced common scores and residual matrices*

Description

This function produces several matrices useful to assess model fit.

Usage

```
residual.CircE(object,file=NULL,digits=3)
```

Arguments

`object`	a circumplex model produced by `CircE.BFGS`.
`file`	a connection or a character string naming the file to write to, or NULL (default) for do not send R output to a file.
`digits`	number of digits for printed output.

Author(s)

Michele Grassi <grassi.mic@gmail.com>

Examples

```
#______ Vocational Interests Scale: Sample Correlation Matrix. N=175 _____

R.vocational=matrix(c(
1,0,0,0,0,0,0,
0.654,1,0,0,0,0,0,
0.453,0.644,1,0,0,0,0,
0.251,0.440,0.757,1,0,0,0,
0.122,0.158,0.551,0.493,1,0,0,
0.218,0.210,0.570,0.463,0.754,1,0,
0.496,0.264,0.366,0.202,0.471,0.650,1
),7,7,byrow=TRUE)
R=R.vocational+t(R.vocational)-diag(diag(R.vocational))

v.names=c("Health","Science","Technology","Trades","Business Operations",
          "Business Contact","Social")
dimnames(R)=list(v.names,v.names)

model=CircE.BFGS(R,v.names,m=3,N=175,r=1)

residual.CircE(model,digits=3)
```

SELF5 *Child Interpersonal Circumplex data*

Description

This data set contains 286 self-reports provided by 5th grade children who rated their interpersonal behavior along 48 items, i.e. six items for each of eight scales octants, conceptually organized around Dominance (DOM) and Love (LOV) domains according to Wiggins' interpersonal circumplex (IPC) model (Wiggins, 1979; Wiggins & Trapnell, 1996). Briefly, Wiggins' model is based on the idea that people in interaction attempt to negotiate relations of hierarchy and cooperation by granting or denying the resources of power (Dominance) and warmth (Love). Accordingly, the IPC model differently combines elements of the reference axes (DOM and LOV) and defines eight possible interpersonal styles circularly ordered around DOM and LOV in compliance with a law of neighboring, positing that two variables are neighbors if they share more variance with each other than with other variables.

Usage

```
data(SELF5)
```

References

Di Blas, L., Grassi, M., Luccio, R., Momente', S. (2012). Assessing the Interpersonal Circumplex Model in Late Childhood: The Interpersonal Behavior Questionnaire for Children. *Assessment*, 19(4), pp. 421-441.
Wiggins, J. S.(1979). A psychological taxonomy of trait-descriptive terms: The interpersonal domain. *Journal of Personality and Social Psychology*, 37 (6), 395-412.
Wiggins, J. S., & Trapnell, P. (1996). A dyadic-interactional perspective on the five-factor model. In J. S. Wiggins (Ed.), *The five-factor model of personality* (pp. 88-162). New York: The Guilford Press.

Examples

```
data(SELF5)

 dim(SELF5)

 RS5<-cor(SELF5,use="pairwise.complete.obs")

 colnames(RS5)
```

Verbal *Verbal Ability Tests correlation matrix*

Description

Intercorrelations of six Verbal Ability Tests for 1046 Bucknell College Sophomores.

Usage

```
data(Verbal)
```

Source

Guttman, L.(1954). A new approach to factor analysis. the radex. In P. F. Lazasrsfeld (Ed.), *Mathematical thinking in the social sciences* (pp. 258-348). New York: Columbia University Press.
Browne, M. W. (1992) Circumplex models for correlation matrices. *Psychometrika*, 57, pp. 469-497.

Examples

```
data(Verbal)
Verbal
```

Index