Package: fanc (via r-universe)

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Type Package

Title Penalized Likelihood Factor Analysis via Nonconvex Penalty

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Depends Matrix, ellipse, tcltk

Description Computes the penalized maximum likelihood estimates of factor loadings and unique variances for various tuning parameters. The pathwise coordinate descent along with EM algorithm is used. This package also includes a new graphical tool which outputs path diagram, goodness-of-fit indices and model selection criteria for each regularization parameter. The user can change the regularization parameter by manipulating scrollbars, which is helpful to find a suitable value of regularization parameter.

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Author Kei Hirose [aut, cre] (<https://orcid.org/0000-0001-9827-0356>), Michio Yamamoto [aut], Haruhisa Nagata [aut]

Maintainer Kei Hirose <mail@keihirose.com>

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Contents

`fanc` *fanc (penalized maximum likelihood factor analysis via nonconvex penalties)*

Description

This package computes the solution path of penalized maximum likelihood estimates via MC+ penalties.

Usage

```
fanc(x, factors, n.obs, rho, gamma, cor.factor=FALSE, normalize=TRUE,
     normalize.penalty=FALSE, covmat, type="MC", model="FA", control=list())
```

Arguments

`x`	A data matrix.
`factors`	The number of factors.
`cor.factor`	An indicator of the factor correlation. If `"TRUE"`, the factor correlation is considered. Default is `"FALSE"`.
`normalize`	If `"TRUE"`, each variable is normalized, otherwise it is left alone.
`normalize.penalty`	If `"TRUE"`, the penalty term for each variable has a weight so that the loading matrix is normalized.
`rho`	The values of rho. It can be a scalar or a matrix.
`gamma`	The values of gamma. It must be a vector.
`covmat`	A covariance matrix, which is needed if the data matrix `"x"` is not available.
`n.obs`	The number of observations, which is needed to calculate the model selection criteria and goodness-of-fit indices when the data matrix `"x"` is not available.
`type`	Type of penalty. If `"MC"`, the MC penalty is used. If `"prenet"`, the prenet penalty is used. If `"enet"`, the elastic penalty is used. Default is `"MC"`.
`model`	Type of model. `"FA"`, the factor analysis model is used. If `"PPCA"`, the probabilistic principal component analysis is conducted. In the PPCA, the unique variances have the same value. Default is `"FA"`.
`control`	A list of control parameters. See 'Details'.

Details

The `control` argument is a list that can supply any of the following components:

`length.rho` Candidates of tuning parameters which is used for grid search of reparametrization of MC+.

`length.gamma` A length of tuning parameter which controls sparsenesses. For each `rho`, `gamma=Inf` yields soft threshold operator (i.e., lasso penalty) and `gamma=+1` produces hard threshold operator.

max.rho Maximum value of rho.

`max.gamma` A maximum value of gamma (excludes `Inf`.).

`min.gamma` A minimum value of gamma.

`eta` A tuning parameter used for preventing the occurrence of improper solutions. `eta` must be non-negative.

`ncand.initial` The number of candidates of initial values of factor loadings.

`ncand.initial.prenet` The number of candidates of initial values for prenet penalty. Because the prenet penalty is unstable when `rho` is large, `ncand.initial.prenet` must be large. Default is 1000.

`maxit.em` A maximum number of iterations for EM algortihm.

`maxit.cd` A maximum number of iterations for coordinate descent algortihm.

`maxit.bfgs` A maximum number of iterations for BFGS algorithm used in the update of factor correlation.

`maxit.initial` A maximum number of iterations for choosing the initial values.

`start` Type of start. If `"cold"`, the initial value of factor loadings is randomly chosen for each tuning parameter, which can be slow.

`Delta` A proportion of maximum value of rho to minimum value of rho, i.e., `rho.min =Delta*rho.max`.

`min.uniquevar` A minimum value of unique variances.

`tol.em` A positive scalar giving the tolerance at which the parameter in EM is considered close enough to zero to terminate the algorithm.

`tol.cd` A positive scalar giving the tolerance at which the factor loadings in coordinate descent is considered close enough to zero to terminate the algorithm.

`tol.bfgs` A positive scalar giving the tolerance at which the factor correlation in BFGS algorithm is considered close enough to zero to terminate the algorithm.

`min.rhozero` If `"TRUE"`, the minimum value of `"rho"` is zero.

`zita` A value of hyper-parameter of factor correlation.

`progress` If `"TRUE"`, the progress for each tuning parameter is displayed.

`openmp` If `"TRUE"`, the parallel computation via OpenMP is excecuted.

`num.threads` The number of threads of the openmp. Only used when `openmp` is `"TRUE"`,

`gamma.ebic` The value of gamma used in the extended BIC

Value

loadings	factor loadings
uniquenesses	unique variances
Phi	factor correlation
rho	rho
AIC	AIC
BIC	BIC
CAIC	CAIC
df	degrees of freedom (number of non-zero parameters for the lasso estimation)
criteria	values of AIC, BIC and CAIC
goodness.of.fit	values of GFI and AGFI
gamma	a value of gamma
Npflag	If the number of observation is larger than the number of variables, 1, otherwise 0.
factors	the number of factors
cor.factor	An indicator of the factor correlation
x	data matrix
convergence	indicator of convergence of EM algorithm, coordinate descent and BFGS. If all of these variables are 0, the algorithm has been converged

Author(s)

Kei Hirose
<mail@keihirose.com>

References

Hirose, K. and Yamamoto, M. (2014). *Sparse estimation via nonconcave penalized likelihood in a factor analysis model*,
Statistics and Computing, in press

See Also

out and plot.fanc objects.

Examples

```
#generate data
set.seed(0)
loadings0 <- matrix(c(rep(0.8,5),rep(0,5),rep(0,5),rep(0.8,5)),10,2)
common.factors0 <- matrix(rnorm(50*2),50,2)
unique.factors0 <- matrix(rnorm(50*10,sd=sqrt(0.36)),50,10)
x <- common.factors0 %*% t(loadings0) + unique.factors0
```

```
#fit data
fit <- fanc(x,2)
fit2 <- fanc(x,2,cor.factor=TRUE) #factor correlation is estimated

#print candidates of gamma and rho
print(fit)

#output for fixed tuning parameters
out(fit, rho=0.1, gamma=Inf)

#select a model via model selection criterion
select(fit, criterion="BIC", gamma=Inf)


#plot solution path
plot(fit)
```

`out` *output from a "fanc" object for fixed value of gamma.*

Description

This functions give us the loadings from a "fanc" object for fixed value of gamma.

Usage

```
out(x, rho, gamma, scores=FALSE, df.method="active")
```

Arguments

`x`	Fitted `"fanc"` model object.
`gamma`	The value of gamma.
`rho`	The value of rho.
`scores`	Logical flag for outputting the factor scores. Defalut is FALSE.
`df.method`	Two types of degrees of freedom are supported. If `"reparametrization"`, the degrees of freedom of the MC+ are reparametrized based on the degrees of freedom of the lasso. If `"active"`, the degrees of freedom of are the number of nonzero parameters.

Value

`loadings`	factor loadings
`uniquenesses`	unique variances
`Phi`	factor correlation
`scores`	factor scores

df	degrees of freedom (number of non-zero parameters for the lasso estimation)
criteria	values of AIC, BIC and CAIC
goodness.of.fit	values of GFI and AGFI
rho	a value of rho
gamma	a value of gamma

Author(s)

Kei Hirose
<mail@keihirose.com>

References

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See Also

fanc and plot.fanc objects.

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plot.fanc *plot the solution path from a "fanc" object.*

Description

This functions plots the solution paths from a "fanc" object for fixed value of gamma.

Usage

```
## S3 method for class 'fanc'
plot(x, Window.Height=500, type=NULL, df.method="active", ...)
```

Arguments

x	Fitted "fanc" model object.
Window.Height	A window height. The default is 500.
type	Two plot types are supported. If "path", the path diagram is depicted. If "heatmap", the heatmap is depicted.
df.method	Two types of degrees of freedom are supported. If "reparametrization", the degrees of freedom of the MC+ are reparametrized based on the degrees of freedom of the lasso. If "active", the degrees of freedom of are the number of nonzero parameters.
...	Other graphical parameters to plot

Value

NULL

Author(s)

Kei Hirose
<mail@keihirose.com>

References

Hirose, K. and Yamamoto, M. (2014). *Sparse estimation via nonconcave penalized likelihood in a factor analysis model*,
Statistics and Computing, in press

See Also

`fanc` and `out` objects.

`select` *select from a "fanc" object for fixed value of gamma.*

Description

This functions give us the loadings from a "fanc" object for fixed value of gamma.

Usage

```
select(x, criterion=c("BIC","AIC","CAIC","EBIC"),
 gamma,  scores=FALSE, df.method="active")
```

Arguments

`x`	Fitted `"fanc"` model object.
`criterion`	The criterion by which to select the tuning parameter rho. One of "AIC", "BIC", "CAIC", or "EBIC". Default is "BIC".
`gamma`	The value of gamma.
`scores`	Logical flag for outputting the factor scores. Defalut is FALSE.
`df.method`	Two types of degrees of freedom are supported. If `"active"`, the degrees of freedom of are the number of nonzero parameters. If `"reparametrization"`, the degrees of freedom of the MC+ are reparametrized based on the degrees of freedom of the lasso.

Value

loadings	factor loadings
uniquenesses	unique variances
Phi	factor correlation
scores	factor scores
df	degrees of freedom (number of non-zero parameters for the lasso estimation)
criteria	values of AIC, BIC and CAIC
goodness.of.fit	values of GFI and AGFI
rho	a value of rho
gamma	a value of gamma

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See Also

fanc and plot.fanc objects.

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