Package ‘gofar’

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R topics documented:

- gofar_control
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gofar_control  Control parameters for the estimation procedure of GOFAR(S) and GOFAR(P)

Description

Default control parameters for Generalized co-sparse factor regression

Usage

gofar_control(maxit = 5000, epsilon = 1e-06, elnetAlpha = 0.95, gamma0 = 1, se1 = 1, spU = 0.5, spV = 0.5, lamMaxFac = 1, lamMinFac = 1e-06, initmaxit = 2000, initepsilon = 1e-06, equalphi = 1, objI = 1, alp = 60)

Arguments

- maxit: maximum iteration for each sequential steps
- epsilon: tolerance value set for convergence of gcure
- elnetAlpha: elastic net penalty parameter
- gamma0: power parameter in the adaptive weights
- se1: apply 1se rule for the model
- spU: maximum proportion of nonzero elements in each column of U
- spV: maximum proportion of nonzero elements in each column of V
**Value**

a list of controlling parameter.

**References**


**Examples**

```r
# control variable for GOFAR(S) and GOFAR(P)
control <- gofar_control()
```

```r
gofar_p(Yt, X, nrank = 3, nlambda = 40, family, familygroup = NULL, cIndex = NULL, ofset = NULL, control = list(), nfold = 5, PATH = FALSE)
```

**Description**

Divide and conquer approach for low-rank and sparse coefficient matrix estimation: Exclusive extraction

**Usage**

gofar_p(Yt, X, nrank = 3, nlambda = 40, family, familygroup = NULL, cIndex = NULL, ofset = NULL, control = list(), nfold = 5, PATH = FALSE)
Arguments

Yt    response matrix
X     covariate matrix; when X = NULL, the function performs unsupervised learning
nrank an integer specifying the desired rank/number of factors
nlambda number of lambda values to be used along each path
family set of family gaussian, bernoulli, possion
familygroup index set of the type of multivariate outcomes: "1" for Gaussian, "2" for Bernoulli, "3" for Poisson outcomes
cIndex control index, specifying index of control variable in the design matrix X
offset offset matrix specified
control a list of internal parameters controlling the model fitting
nfold number of fold for cross-validation
PATH TRUE/FALSE for generating solution path of sequential estimate after cross-validation step

Value

C     estimated coefficient matrix; based on GIC
Z     estimated control variable coefficient matrix
Phi   estimated dispersion parameters
U     estimated U matrix (generalize latent factor weights)
D     estimated singular values
V     estimated V matrix (factor loadings)
lam   selected lambda values based on the chosen information criterion
lampath sequences of lambda values used in model fitting. In each sequential unit-rank estimation step, a sequence of length nlambda is first generated between (lam-MaxlamMaxFac, lamMaxlamMaxFac*lamMinFac) equally spaced on the log scale, in which lamMax is estimated and the other parameters are specified in gofar_control. The model fitting starts from the largest lambda and stops when the maximum proportion of nonzero elements is reached in either u or v, as specified by spU and spV in gofar_control.
IC    values of information criteria
Upath solution path of U
Dpath solution path of D
Vpath solution path of D
ObjDec boolean type matrix outcome showing if objective function is monotone decreasing or not.
familygroup specified familygroup of outcome variables.

References

Examples

```r
gofar_s

Examples

family <- list(gaussian(), binomial(), poisson())
control <- gofar_control()
nlam <- 40  # number of tuning parameter
SD <- 123

# Simulated data for testing
data('simulate_gofar')
attach(simulate_gofar)
q <- ncol(Y)
p <- ncol(X)
# Simulate data with 20% missing entries
miss <- 0.20  # Proportion of entries missing
t.ind <- sample.int(n * q, size = miss * n * q)
y <- as.vector(Y)
y[t.ind] <- NA
Ym <- matrix(y, n, q)
naind <- (!is.na(Ym)) + 0  # matrix(1,n,q)
misind <- any(naind == 0) + 0
# # Model fitting begins:
control$epsilon <- 1e-7
control$spU <- 50 / p
control$spV <- 25 / q
control$maxit <- 1000
# Model fitting: GOFAR(P) (full data)
set.seed(SD)
rank.est <- 5

fit.eea <- gofar_p(Y, X,
nrank = rank.est, nlambda = nlam,
family = family, familygroup = familygroup,
control = control, nfold = 5)

# Model fitting: GOFAR(P) (missing data)
set.seed(SD)
rank.est <- 5
fit.eea.m <- gofar_p(Ym, X,
nrank = rank.est, nlambda = nlam,
family = family, familygroup = familygroup,
control = control, nfold = 5)
```

**gofar_s**

Generalize Sequential factor extraction via co-sparse unit-rank estimation (GOFAR(S)) using k-fold crossvalidation
Description

Divide and conquer approach for low-rank and sparse coefficient matrix estimation: Sequential

Usage

gofar_s(
  Yt,  
  X,   
  nrank = 3,  
  nlambda = 40,  
  family,    
  familygroup = NULL,  
  cIndex = NULL,  
  ofset = NULL,  
  control = list(),  
  nfold = 5,  
  PATH = FALSE
)

Arguments

Yt     response matrix
X      covariate matrix; when X = NULL, the function performs unsupervised learning
nrank  an integer specifying the desired rank/number of factors
nlambda number of lambda values to be used along each path
family  set of family gaussian, bernoulli, poission
familygroup index set of the type of multivariate outcomes: "1" for Gaussian, "2" for Bernoulli, "3" for Poisson outcomes
cIndex control index, specifying index of control variable in the design matrix X
ofset offset matrix specified
control a list of internal parameters controlling the model fitting
nfold number of folds in k-fold crossvalidation
PATH TRUE/FALSE for generating solution path of sequential estimate after cross-validation step

Value

C estimated coefficient matrix; based on GIC
Z estimated control variable coefficient matrix
Phi estimated dispersion parameters
U estimated U matrix (generalize latent factor weights)
D estimated singular values
V estimated V matrix (factor loadings)
lam selected lambda values based on the chosen information criterion
familygroup specified familygroup of outcome variables.
fitCV output from crossvalidation step, for each sequential step
Examples

```r
family <- list(gaussian(), binomial(), poisson())
control <- gofar_control()
nlam <- 40 # number of tuning parameter
SD <- 123

# Simulated data for testing
data('simulate_gofar')
attach(simulate_gofar)
q <- ncol(Y)
p <- ncol(X)

# Simulate data with 20% missing entries
miss <- 0.20 # Proportion of entries missing
t.ind <- sample.int(n * q, size = miss * n * q)
y <- as.vector(Y)
y[t.ind] <- NA
Ym <- matrix(y, n, q)
naind <- (!is.na(Ym)) + 0 # matrix(1,n,q)
misind <- any(naind == 0) + 0

# Model fitting begins:
control$epsilon <- 1e-7
control$spU <- 50 / p
control$spV <- 25 / q
control$maxit <- 1000

# Model fitting: GOFAR(S) (full data)
set.seed(SD)
rank.est <- 5
fit.seq <- gofar_s(Y, X,
  nrank = rank.est, family = family,
  nlambda = nlam, familygroup = familygroup,
  control = control, nfold = 5
)

# Model fitting: GOFAR(S) (missing data)
set.seed(SD)
rank.est <- 5
fit.seq.m <- gofar_s(Ym, X,
  nrank = rank.est, family = family,
  nlambda = nlam, familygroup = familygroup,
  control = control, nfold = 5
)
```

References

gofar_sim

Simulate data for GOFAR

Description

Generate random samples from a generalize sparse factor regression model

Usage

gofar_sim(U, D, V, n, Xsigma, C0, familygroup, snr)

Arguments

U specified value of U
D specified value of D
V specified value of V
n sample size
Xsigma covariance matrix for generating sample of X
C0 Specified coefficient matrix with first row being intercept
familygroup index set of the type of multivariate outcomes: "1" for Gaussian, "2" for Bernoulli, "3" for Poisson outcomes
snr signal to noise ratio specified for gaussian type outcomes

Value

Y Generated response matrix
X Generated predictor matrix
sigmaG standard deviation for gaussian error

References

Examples

```r
## Model specification:
SD <- 123
set.seed(SD)
n <- 200
p <- 100
pz <- 0
# Model I in the paper
# n <- 200; p <- 300; pz <- 0 ; # Model II in the paper
# q1 <- 0; q2 <- 30; q3 <- 0 # Similar response cases
q1 <- 15
q2 <- 15
q3 <- 0 # mixed response cases
nrank <- 3 # true rank
rank.est <- 4 # estimated rank
nlam <- 40 # number of tuning parameter
s <- 1 # multiplying factor to singular value
snr <- 0.25 # SNR for variance Gaussian error
#
q <- q1 + q2 + q3
respFamily <- c("gaussian", "binomial", "poisson")
family <- list(gaussian(), binomial(), poisson())
familygroup <- c(rep(1, q1), rep(2, q2), rep(3, q3))
cfamily <- unique(familygroup)
nfamily <- length(cfamily)
#
control <- gofar_control()
#
## Generate data
D <- rep(0, nrank)
V <- matrix(0, ncol = nrank, nrow = q)
U <- matrix(0, ncol = nrank, nrow = p)
#
U[, 1] <- c(sample(c(1, -1), 8, replace = TRUE), rep(0, p - 8))
U[, 2] <- c(rep(0, 20), sample(c(1, -1), 9, replace = TRUE), rep(0, p - 28))
U[, 3] <- c(rep(0, 11), sample(c(1, -1), 9, replace = TRUE), rep(0, p - 30))
#
if (nfamily == 1) {
  # for similar type response type setting
  V[, 1] <- c(rep(0, 8), sample(c(1, -1), 8, replace = TRUE), rep(0, p - 8))
  V[, 2] <- c(rep(0, 20), sample(c(1, -1), 9, replace = TRUE), rep(0, p - 28))
  V[, 3] <- c(rep(0, 11), sample(c(1, -1), 9, replace = TRUE), rep(0, p - 30))
  V[, 1] <- c(rep(0, 8), sample(c(1, -1), 8, replace = TRUE) * runif(8, 0.3, 1), rep(0, q - 16))
  V[, 2] <- c(rep(0, 20), sample(c(1, -1), 9, replace = TRUE) * runif(9, 0.3, 1), rep(0, q - 28))
  V[, 3] <- c(sample(c(1, -1), 5, replace = TRUE) * runif(5, 0.3, 1), rep(0, 23),
             sample(c(1, -1), 2, replace = TRUE) * runif(2, 0.3, 1), rep(0, q - 30))
```
else {
  # for mixed type response setting
  # V is generated such that joint learning can be emphasised
  V1 <- matrix(0, ncol = nrank, nrow = q / 2)
  V1[, 1] <- c(sample(c(1, -1), 5, replace = TRUE), rep(0, q / 2 - 5))
  V1[, 2] <- c(
    rep(0, 3), V1[4, 1], -1 * V1[5, 1],
    sample(c(1, -1), 3, replace = TRUE), rep(0, q / 2 - 8)
  )
  V1[, 3] <- c(
    V1[1, 1], -1 * V1[2, 1], rep(0, 4),
    V1[7, 2], -1 * V1[8, 2], sample(c(1, -1), 3, replace = TRUE),
    rep(0, q / 2 - 10)
  )
  V2 <- matrix(0, ncol = nrank, nrow = q / 2)
  V2[, 1] <- c(sample(c(1, -1), 5, replace = TRUE), rep(0, q / 2 - 5))
  V2[, 2] <- c(
    rep(0, 3), V2[4, 1], -1 * V2[5, 1],
    sample(c(1, -1), 3, replace = TRUE), rep(0, q / 2 - 8)
  )
  V2[, 3] <- c(
    V2[1, 1], -1 * V2[2, 1], rep(0, 4),
    V2[7, 2], -1 * V2[8, 2],
    sample(c(1, -1), 2, replace = TRUE), rep(0, q / 2 - 10)
  )
  V <- rbind(V1, V2)
}
U[, 1:3] <- apply(U[, 1:3], 2, function(x) x / sqrt(sum(x^2)))
V[, 1:3] <- apply(V[, 1:3], 2, function(x) x / sqrt(sum(x^2)))
# D <- s * c(4, 6, 5) # signal strength varies as per the value of s
or <- order(D, decreasing = TRUE)
U <- U[, or]
V <- V[, or]
D <- D[or]
C <- U %*% (D * t(V)) # simulated coefficient matrix
intercept <- rep(0.5, q) # specifying intercept to the model:
C0 <- rbind(intercept, C)
# Xsigma <- 0.5^abs(outer(1:p, 1:p, FUN = "-"))
# Simulated data
sim.sample <- gofar_sim(U, D, n, Xsigma, C0, familygroup, snr)
# Dispersion parameter
pHI <- c(rep(sim.sample$sigmaG, q1), rep(1, q2), rep(1, q3))
X <- sim.sample$X[n:n]
Y <- sim.sample$Y[n:n]
simulate_gofar <- list(Y = Y, X = X, U = U, D = D, V = V, n=n,
  Xsigma = Xsigma, C0 = C0, familygroup = familygroup)
Simulate gofar

Simulated data for GOFAR

Description
Simulated data with low-rank and sparse coefficient matrix.

Usage
data(simulate_gofar)

Format
A list of variables for the analysis using GOFAR(S) and GOFAR(P):

- **Y**: Generated response matrix
- **X**: Generated predictor matrix
- **U**: specified value of U
- **V**: specified value of V
- **D**: specified value of D
- **n**: sample size
- **Xsigma**: covariance matrix used to generate predictors in X
- **C0**: intercept value in the coefficient matrix

**familygroup** index set of the type of multivariate outcomes: "1" for Gaussian, "2" for Bernoulli, "3" for Poisson outcomes

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