Package 'IIVpredictor'

May 18, 2021

Type Package

Title Modeling Within Individual Variability as Predictor

Version 0.1.0

Description Time parceling method and Bayesian variability modeling methods for modeling within individual variability indicators as predictors.For more details, see <https://github.com/xliu12/IIVpredicitor>.

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Encoding UTF-8

Imports R2jags, lavaan

RoxygenNote 7.1.1

Suggests knitr, rmarkdown, testthat (>= 2.0.0)

VignetteBuilder knitr

Config/testthat/edition 2

Depends R (>= 2.10)

NeedsCompilation no

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Repository CRAN

Date/Publication 2021-05-18 14:10:19 UTC

R topics documented:

ISD.BV   *Bayesian variability modeling method for modeling intraindividual standard deviation as a predictor*

Description

Intraindividual mean and standard deviation are modeled as predictors of an outcome variable using Bayesian approach, where hyper priors are specified for the true (i.e., latent) intraindividual mean and standard deviation.

Usage

```
ISD.BV(
  compx,
  y,
  ReMeasure
  , nchains=2, niter=8000
)
```

Arguments

compx	an N*T (N: number of individuals; T: number of measurement occasions) matrix containing wide format repeated measures of a time varying independent variable X
y	a column vector of length N containing a single measurement of the outcome variable y
ReMeasure	measurement scale reliability of the time varying independent variable X
nchains	number of Markov chains (default: 2)
niter	number of total iterations per chain (including burn in; default: 8000)

Details

For each individual, the predictor score at occasion t is assumed to follow a normal distribution:

$x\_it : N(mux\_i, (sigmav\_i)$^2 + sigmaex^2),

where the intraindividual variance (sigmav_i)^2 is modeled as *sigmav_i^2 : Gamma(location, scale)* with unknown location and scale parameters; and the intraindividual mean (mux_i) as *mux_i : N(mu_mux, sigma_mux^2)*. The measurement scale reliability of X ("ReMeasure") is used to help identify the model, where we set *sigmaex^2 = (1− ReMeasure)*(sigma_mux^2+location*scale)/ReMeasure*.

For predicting outcome Y, we assume *y_i : N(beta_0+beta_IM*mux_i+beta_IIV*sigmav_i, sigmay^2)*.

Half Cauchy priors are used as a weakly informative prior for location, 1/scale, sigma_mux, and sigmay. Noninformative normal priors,N(0,0.001^2) are used for the regression coefficients. R JAGS is used to implement the MCMC sampling.

Value

IVAR.BV returns a data.frame named "res" containing the mean("Estimate"), standard deviation ("Std.err"), 0.025 and 0.975 quantiles of the posterior distributions of the effects of the intraindividual standard deviation ("beta_IIV") and intraindividual mean ("beta_IM") of X (the time varying indenpendent variable) on Y (the outcome variable), , and their corresponding Rhat (the potential scale reduction factor of the Gelman Rubin convergence dignositic) values.

Examples

```
#  Population Values
# IM: mux_i : N(0, var=9)
sigma_mu=sqrt(9);
# IIV: sigmasqx_i : Gamma(shape=0.25, scale=17)
shape=0.25;
scale=17;
# measurement error
sigma_e=sqrt(1.8) # such that the measurement scale reliability is .88
# y_i = beta_mu*IM_i + beta_IIV*ISD_i + epsilon_i
# epsilon_i : N(0,1)
beta_mu=1;
sigma_ep=1

# beta_IIV is beta2 for ISD
beta_IIV=c(0,0.3,0.8,1.50)[2]
N=c(200,500)[1]
T=c(6,9,12)[2]


#  Data Generation
set.seed(12)
mu=rnorm(N,0,sigma_mu)
IIV=rgamma(N,shape=shape,scale=scale) #sigmasq_vi
isd=sqrt(IIV)
# population regression model
# y=0+beta_mu*mu+beta_IIV*IIV+rnorm(N,0,sigma_ep)
# use ISD as predictor
y=0+beta_mu*mu+beta_IIV*isd+rnorm(N,0,sigma_ep)

x=v=compx=array(0,c(N,T))
for (i in 1:N) {
  v[i,]=mu[i]+rnorm(T,0,isd[i])
  x[i,]=v[i,]+rnorm(T,0,sigma_e)
  compx[i,]=x[i,]
}


ISD.BV(
  compx,
  y,
  ReMeasure=0.88
```

```
  , nchains=2, niter=10
)
```

IVAR.BV	*Bayesian variability modeling method for modeling intraindividual variance as a predictor*

Description

Intraindividual mean and variance are modeled as predictors of an outcome variable using Bayesian approach, where hyper priors are specified for the true (i.e., latent) intraindividual mean and variance.

Usage

```
IVAR.BV(
  compx,
  y,
  ReMeasure
  , nchains=2, niter=8000
)
```

Arguments

compx	an N*T (N: number of individuals; T: number of measurement occasions) matrix containing wide format repeated measures of a time varying independent variable X.
y	a column vector of length N containing a single measurement of the outcome variable y.
ReMeasure	measurement scale reliability of the time varying independent variable X.
nchains	number of Markov chains (default: 2).
niter	number of total iterations per chain (including burn in; default: 8000).

Details

For each individual, the predictor score at occasion t is assumed to follow a normal distribution:

$x\_it : N(mux\_i, (sigmav\_i)^2 + sigmaex^2)$,

where the intraindividual variance (sigmav_i)^2 is modeled as *$sigmav\_i^2 : Gamma(location, scale)$* with unknown location and scale parameters; and the intraindividual mean (mux_i) as *$mux\_i : N(mu\_mux, sigma\_mux^2)$*. The measurement scale reliability of X ("ReMeasure") is used to help identify the model, where we set *$sigmaex^2 = (1 - ReMeasure)*(sigma\_mux^2 + location*scale)/ReMeasure$*.

For predicting outcome Y, we assume *$y\_i : N(beta\_0 + beta\_IM*mux\_i + beta\_IIV*(sigmav\_i)^2, sigmay^2)$*.

Half Cauchy priors are used as a weakly informative prior for location, 1/scale, sigma_mux, and sigmay. Noninformative normal priors,N(0,0.001^2) are used for the regression coefficients. R JAGS is used to implement the MCMC sampling.

Value

IVAR.BV returns a data.frame named "res" containing the mean("Estimate"), standard deviation ("Std.err"), 0.025 and 0.975 quantiles of the posterior distributions of the effects of the intraindividual variance ("beta_IIV") and intraindividual mean ("beta_IM") of X (the time varying independent variable) on Y (the outcome variable), and their corresponding Rhat (the potential scale reduction factor of the Gelman Rubin convergence diagnositic) values.

Examples

```
#  Population Values
# IM: mux_i : N(0, var=9)
sigma_mu=sqrt(9);
# IIV: sigmasqx_i : Gamma(shape=0.25, scale=17)
shape=0.25;
scale=17;
# measurement error
sigma_e=sqrt(1.8) # such that the measurement scale reliability is .88
# y_i = beta_mu*IM_i + beta_IIV*ISD_i + epsilon_i
# epsilon_i : N(0,1)
beta_mu=1;
sigma_ep=1

# beta_IIV is beta2 for ISD
beta_IIV=c(0,0.3,0.8,1.50)[2]
N=c(200,500)[1]
T=c(6,9,12)[2]


#  Data Generation
set.seed(12)
mu=rnorm(N,0,sigma_mu)
IIV=rgamma(N,shape=shape,scale=scale) #sigmasq_vi
isd=sqrt(IIV)
# population regression model
# y=0+beta_mu*mu+beta_IIV*IIV+rnorm(N,0,sigma_ep)
# use ISD as predictor
y=0+beta_mu*mu+beta_IIV*isd+rnorm(N,0,sigma_ep)

x=v=compx=array(0,c(N,T))
for (i in 1:N) {
  v[i,]=mu[i]+rnorm(T,0,isd[i])
  x[i,]=v[i,]+rnorm(T,0,sigma_e)
  compx[i,]=x[i,]
}
```

```
IVAR.BV(
  compx,
  y,
  ReMeasure=0.88
  , nchains=2, niter=10
)
```

IVAR.TPB   *Time parceling (with bootstrap) method for modeling intraindividual*
                           variance as a predictor

Description

Use observed intraindividual means and variances of multiple (e.g., 3) time parcels as manifest
indicators of true (latent) intraindividual mean and variance respectively to predict an outcome
variable in a structural equation model (SEM).

Usage

```
IVAR.TPB(
  compx,
  y,
  nB=1000
)
```

Arguments

compx   an N*T (N: number of individuals; T: number of measurement occasions) ma-
               trix containing wide format repeated measures of a time varying independent
               variable X.

y   a column vector of length N containing the outcome variable Y.

nB   number of bootstrap samples (default: 1000).

Details

A fixed number (numpar = 3) of time parcels are formed for each individual using the individual's
repeated measures of the independent variable X at T occasions. The time parcels are created by
cutting the sequence 1,2,...,T into three intervals of (approximately) equal length (about T/numpar).
Then for each individual, sample intraindividual means and variances of the created time parcels
are computed and used as manifest indicators of the individual's true (latent) intraindividual mean
and variance respectively to predict the individual's outcome score in a structural equation model
(SEM). Sampling (i.e., sampling individuals from population) variablility of the parameter estimates
is accounted for using the Bootstrap approach. #nB bootstrap samples are drawn to estimate the
standard errors and 0.95 confidence intervals.

Value

IVAR.TPB returns a list "reslist" containing two components.

res   a data.frame named "res" containing the estimates ("Estimate"), standard error
                estimates ("Std.err"), and lower and upper bounds of 0.95 confidence intervals of
                the effects of the intraindividual variance ("beta_IIV") and intraindividual mean
                ("beta_IM") of X (the time varying indenpendent variable) on Y (the outcome
                variable).

convergence   convergence rate of the bootstrap samples.

Examples

```
#  Population Values
# IM: mux_i  N(0, var=9)
sigma_mu=sqrt(9);
# IIV: sigmasqx_i  Gamma(shape=0.25, scale=17)
shape=0.25;
scale=17;
# measurement error
sigma_e=sqrt(1.8) # such that the measurement scale reliability is .88
# y_i = beta_mu*IM_i + beta_IIV*ISD_i + epsilon_i
# epsilon_i  N(0,1)
beta_mu=1;
sigma_ep=1

# beta_IIV is beta2 for ISD
beta_IIV=c(0,0.3,0.8,1.50)[2]
N=c(200,500)[1]
T=c(6,9,12)[2]

#  Data Generation
set.seed(12)
mu=rnorm(N,0,sigma_mu)
IIV=rgamma(N,shape=shape,scale=scale) #sigmasq_vi
isd=sqrt(IIV)
# population regression model
# y=0+beta_mu*mu+beta_IIV*IIV+rnorm(N,0,sigma_ep)
# use ISD as predictor
y=0+beta_mu*mu+beta_IIV*isd+rnorm(N,0,sigma_ep)

x=v=compx=array(0,c(N,T))
for (i in 1:N) {
  v[i,]=mu[i]+rnorm(T,0,isd[i])
  x[i,]=v[i,]+rnorm(T,0,sigma_e)
  compx[i,]=x[i,]
}

IVAR.TPB(
  compx,
  y,
```

```
    nB=10
)
```

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