Package 'BayesSingleSub'

February 19, 2015

Type Package

Title Computation of Bayes factors for interrupted time-series designs

Version 0.6.2

Date 2014-01-22

Author Richard D. Morey, Rivka de Vries

Maintainer Richard D. Morey <richarddmorey@gmail.com>

Description The BayesSingleSub package is a suite of functions for computing various Bayes factors for interrupted time-series, based on the models described in de Vries and Morey (2013).

License GPL-2

VignetteBuilder knitr

Depends R (>= 3.0.0)

Suggests knitr

Imports coda, mvtnorm, MCMCpack

LazyLoad yes

NeedsCompilation yes

Repository CRAN

Date/Publication 2014-01-22 16:23:18

R topics documented:

BayesSingleSub-package 2
trendtest.Gibbs.AR 3
trendtest.MC.AR 5
ttest.Gibbs.AR 7
ttest.MCGQ.AR 9

Index **12**

`BayesSingleSub-package`

Functions to obtain Bayes factor hypothesis tests and posterior samples of parameters for single case data.

Description

This package contains functions to compute Bayes factors for the mean difference, trend difference, and intercept difference in single case data sequences. Some functions also provide posterior samples of parameters and interval null Bayes factors.

Details

Package:	BayesSingleSub
Type:	Package
Version:	0.6.1
Date:	2012-11-28
License:	GPL 2.0
LazyLoad:	yes

The following functions are currently implemented, with more to follow:

ttest.Gibbs.AR(): Compute Bayes factor for mean difference using Gibbs sampling and obtain posterior samples of parameters ttest.MCGQ.AR(): Compute Bayes factor for mean difference using monte carlo or gaussian quadrature integration trendtest.Gibbs.AR(): Compute Bayes factors for trend and intercept differences using Gibbs sampling and obtain posterior samples of parameters trendtest.MC.AR(): Compute Bayes factors for trend and intercept differences using monte carlo integration

Author(s)

Richard D. Morey and Rivka de Vries

Maintainer: Richard D. Morey <richarddmorey@gmail.com>

References

De Vries, R. M. \& Morey, R. D. (submitted). Bayesian hypothesis testing Single-Subject Data. Psychological Methods.

R code guide: http://drsmorey.org/research/rdmorey/

Examples

```
## See specific functions for examples
```

`trendtest.Gibbs.AR` *Obtain Bayesian trend test and posterior distributions for single case data*

Description

This function computes Bayes factors for the trend and intercept differences between two phases of a single subject data sequence, using Gibbs sampling. Posterior samples of parameters are also provided.

Usage

```
trendtest.Gibbs.AR(before, after, iterations = 1000,
                   intArea = c(-0.2,0.2), slpArea = c(-0.2, 0.2),
                   leftSidedInt = TRUE, leftSidedSlp = TRUE,
                   r.scaleInt = 1, r.scaleSlp = 1,
  alphaTheta = 1, betaTheta = 5, sdMet = 0.3,
                   progress = TRUE, return.chains = FALSE,
                   return.onesided = FALSE)
```

Arguments

`before`	A vector of observations, in time order, taken in Phase 1 (e.g., before the treatment).
`after`	A vector of observations, in time order, taken in Phase 2 (e.g., after the treatment).
`iterations`	Number of Gibbs sampler iterations to perform.
`intArea`	Only used if `return.chains=TRUE`. Bounds for the interval null hypothesis for the intercept difference.
`slpArea`	Only used if `return.chains=TRUE`. Bounds for the interval null hypothesis for the trend difference.
`leftSidedInt`	Only used if `return.onesided = TRUE`. Should the one sided Bayes factor for the intercept difference be one sided?
`leftSidedSlp`	Only used if `return.onesided = TRUE`. Should the one sided Bayes factor for the trend difference be one sided?
`r.scaleInt`	Prior scale for the intercept difference (see Details below).
`r.scaleSlp`	Prior scale for the trend difference (see Details below).
`alphaTheta`	The alpha parameter of the beta prior on theta (see Details below).
`betaTheta`	The beta parameter of the beta prior on theta (see Details below).
`sdMet`	Scale for the Metropolis-Hastings sampling of theta (see Details below).
`progress`	Report progress with a text progress bar?
`return.chains`	Return posterior samples of parameters?.
`return.onesided`	Return one sided Bayes factors?

Details

This function computes Bayes factors for the differences in trend and intercept between two data sequences from a single subject, using Gibbs sampling. The Bayes factor for trend difference compares the null hypothesis of no true trend difference against the alternative hypothesis of a true trend difference. The Bayes factor for intercept difference compares the null hypothesis of no true intercept difference against the alternative hypothesis of a true intercept difference. Also, a joined Bayes factor for the trend and intercept combined is provided. Bayes factors larger than 1 support the null hypothesis, Bayes factors smaller than 1 support the alternative hypothesis. Auto-correlation of the errors is modeled by a first order auto-regressive process.

Posterior distributions of the model parameters can also be obtained. Model parameters of interest include mu0 (overall mean), sig*delta (difference between intercepts), beta0 (overall trend), sig*beta1 (difference between trends), sig2 (variance of the random shocks), and rho (auto-correlation).

Cauchy priors are placed on the standardized trend and intercept differences. The `r.scaleInt` and `r.scaleSlp` arguments control the scales of these Cauchy priors, with `r.scaleInt = 1` and `r.scaleSlp = 1` yielding standard Cauchy priors. A noninformative Jeffreys prior is placed on the variance of the random shocks of the auto-regressive process. A beta prior is placed on the auto-correlation theta. The `alphaTheta` and `betaTheta` arguments control the form of this beta prior.

Missing data are sampled from the likelihood function, conditioned at the observed data, at each iteration of the Gibbs sampler.

Value

A list containing the following:

`logbf`	MCMC estimates of the log two sided point null Bayes factors, computed using the Savage-Dickey method (Morey, Rouder, Pratte, and Speckman, submitted).
`chains`	Only returned if `return.chains=TRUE`. An object of type MCMC containing the chains for each parameter.
`acc`	Only returned if `return.chains=TRUE`. The Metropolis-Hastings acceptance rate.
`logbfArea`	Only returned if `return.chains=TRUE`. MCMC estimates of the log two sided interval null Bayes factors.
`logbfOnesided`	Only returned if `return.onesided=TRUE`. MCMC estimates of the log one sided point null Bayes factors.

Note

For a more accurate method of computing the Bayes factor, see `trendtest.MC.AR`.

Author(s)

Richard D. Morey and Rivka de Vries

References

De Vries, R. M. \& Morey, R. D. (submitted). Bayesian hypothesis testing Single-Subject Data. Psychological Methods.

R code guide: http://drsmorey.org/research/rdmorey/

See Also

trendtest.MC.AR, ttest.Gibbs.AR, ttest.MCGQ.AR

Examples

```
## Define data
data = c(87.5, 82.5, 53.4, 72.3, 94.2, 96.6, 57.4, 78.1, 47.2,
 80.7, 82.1, 73.7, 49.3, 79.3, 73.3, 57.3, 31.7, 50.4, 77.8,
 67, 40.5, 1.6, 38.6, 3.2, 24.1)

## Obtain log Bayes factors
logBFs = trendtest.Gibbs.AR(data[1:10], data[11:25])

## Obtain log Bayes factors, chains, and log interval null Bayes factors
output = trendtest.Gibbs.AR(data[1:10], data[11:25],
        return.chains = TRUE, intArea = c(-0.2,0.2),
        slpArea = c(-0.2, 0.2))

## Look at the posterior distribution of the mean
plot(output$chains[,1])

## Obtain summary statistics of posterior distributions
summary(output$chains)
```

---

trendtest.MC.AR *Obtain Bayesian trend test or single case data*

Description

This function computes Bayes factors for the trend and intercept differences between two phases of a single subject data sequence, using Monte Carlo integration.

Usage

```
trendtest.MC.AR(before, after, iterations = 1000,
                r.scaleInt = 1, r.scaleSlp = 1,
                alphaTheta = 1, betaTheta = 5,
                progress = TRUE)
```

Arguments

before	A vector of observations, in time order, taken in Phase 1 (e.g., before the treatment).
after	A vector of observations, in time order, taken in Phase 2 (e.g., after the treatment).
iterations	Number of Gibbs sampler iterations to perform.
r.scaleInt	Prior scale for the intercept difference (see Details below).
r.scaleSlp	Prior scale for the trend difference (see Details below).
alphaTheta	The alpha parameter of the beta prior on theta (see Details below).
betaTheta	The beta parameter of the beta prior on theta (see Details below).
progress	Report progress with a text progress bar?

Details

This function computes Bayes factors for the differences in trend and intercept between two data sequences from a single subject, using monte carlo integration. The Bayes factor for trend difference compares the null hypothesis of no true trend difference against the alternative hypothesis of a true trend difference. The Bayes factor for intercept difference compares the null hypothesis of no true intercept difference against the alternative hypothesis of a true intercept difference. Also, a joined Bayes factor for the trend and intercept combined is provided. Bayes factors larger than 1 support the null hypothesis, Bayes factors smaller than 1 support the alternative hypothesis. Auto-correlation of the errors is modeled by a first order auto-regressive process.

Cauchy priors are placed on the standardized trend and intercept differences. The `r.scaleInt` and `r.scaleSlp` arguments control the scales of these Cauchy priors, with `r.scaleInt = 1` and `r.scaleSlp = 1` yielding standard Cauchy priors. A noninformative Jeffreys prior is placed on the variance of the random shocks of the auto-regressive process. A beta prior is placed on the auto-correlation theta. The `alphaTheta` and `betaTheta` arguments control the form of this beta prior.

Missing data are handled by removing the locations of the missing data from the design matrix and error covariance matrix.

Value

A matrix containing the Monte carlo estimates of the log Bayes factors.

Note

To obtain posterior distributions and interval null Bayes factors, see `trendtest.Gibbs.AR`.

Author(s)

Richard D. Morey and Rivka de Vries

References

De Vries, R. M. \& Morey, R. D. (submitted). Bayesian hypothesis testing Single-Subject Data. Psychological Methods.

R code guide: http://drsmorey.org/research/rdmorey/

See Also

trendtest.Gibbs.AR, ttest.Gibbs.AR, ttest.MCGQ.AR

Examples

```
## Define data
data = c(87.5, 82.5, 53.4, 72.3, 94.2, 96.6, 57.4, 78.1, 47.2,
 80.7, 82.1, 73.7, 49.3, 79.3, 73.3, 57.3, 31.7, 50.4, 77.8,
 67, 40.5, 1.6, 38.6, 3.2, 24.1)

## Obtain log Bayes factors
logBFs = trendtest.MC.AR(data[1:10], data[11:25])
```

---

ttest.Gibbs.AR *Obtain Bayesian t test and posterior distributions for single case data*

Description

This function computes Bayes factors for the mean difference between two phases of a single subject data sequence, using Gibbs sampling. Posterior samples of parameters are also provided.

Usage

```
ttest.Gibbs.AR(before, after, iterations = 1000, areaNull = c(-0.2, 0.2),
             leftSided = TRUE, treat = NULL, r.scale = 1, alphaTheta = 1,
          betaTheta = 5, sdMet = 0.3, progress = TRUE,
             return.chains = FALSE, return.onesided = FALSE)
```

Arguments

before	A vector of observations, in time order, taken in Phase 1 (e.g., before the treatment).
after	A vector of observations, in time order, taken in Phase 2 (e.g., after the treatment).
iterations	Number of Gibbs sampler iterations to perform.
areaNull	Only used if return.chains=TRUE. Bounds for the interval null hypothesis for delta.
leftSided	Only used if return.onesided=TRUE. Should the one sided Bayes factor be left sided?

`treat`	Vector of dummy coding, indicating Phase 1 and Phase 2; default is -.5 for Phase 1 and .5 for Phase 2.
`r.scale`	Prior scale for delta (see Details below).
`alphaTheta`	The alpha parameter of the beta prior on theta (see Details below).
`betaTheta`	The beta parameter of the beta prior on theta (see Details below).
`sdMet`	Scale for the Metropolis-Hastings sampling of theta (see Details below).
`progress`	Report progress with a text progress bar?
`return.chains`	Return posterior samples of parameters and area null Bayes factor?.
`return.onesided`	Return one sided Bayes factor?

Details

This function computes Bayes factors for the mean difference between two data sequences from a single subject, using Gibbs sampling. The Bayes factors compare null hypotheses of no true mean difference against alternative hypotheses of a true mean difference. A Bayes factor larger than 1 supports the null hypothesis, a Bayes factor smaller than 1 supports the alternative hypothesis. Auto-correlation of the errors is modeled by a first order auto-regressive process.

Posterior distributions of the model parameters can also be obtained. Model parameters of interest include mu0 (overall mean), delta (standardized mean difference), sig2 (variance of the random shocks), and rho (auto-correlation).

A Cauchy prior is placed on the standardized mean difference delta. The `r.scale` argument controls the scale of this Cauchy prior, with `r.scale=1` yielding a standard Cauchy prior. A noninformative Jeffreys prior is placed on the variance of the random shocks of the auto-regressive process. A beta prior is placed on the auto-correlation rho. The `alphaTheta` and `betaTheta` arguments control the form of this beta prior.

Missing data are sampled from the likelihood function, conditioned at the observed data, at each iteration of the Gibbs sampler.

Value

A list containing the following:

`logbf`	An MCMC estimate of the log two sided point null Bayes factor, computed using the Savage-Dickey method (Morey, Rouder, Pratte, and Speckman, submitted).
`chains`	Only returned if `return.chains=TRUE`. An object of type MCMC containing the chains for each parameter.
`acc`	Only returned if `return.chains=TRUE`. The Metropolis-Hastings acceptance rate.
`logbfArea`	Only returned if `return.chains=TRUE`. An MCMC estimate of the log two sided interval null Bayes factor.
`logbfOnesided`	Only returned if `return.onesided=TRUE`. An MCMC estimate of the log one sided point null Bayes factor.

Note

For a more accurate method of computing the Bayes factor, see ttest.MCGQ.AR.

Author(s)

Richard D. Morey and Rivka de Vries

References

De Vries, R. M. \& Morey, R. D. (submitted). Bayesian hypothesis testing Single-Subject Data. Psychological Methods.

R code guide: http://drsmorey.org/research/rdmorey/

See Also

ttest.MCGQ.AR, trendtest.Gibbs.AR, trendtest.MC.AR

Examples

```
## Define data
data = c(87.5, 82.5, 53.4, 72.3, 94.2, 96.6, 57.4, 78.1, 47.2,
 80.7, 82.1, 73.7, 49.3, 79.3, 73.3, 57.3, 31.7, 50.4, 77.8,
 67, 40.5, 1.6, 38.6, 3.2, 24.1)

## Obtain log Bayes factor
logBF = ttest.Gibbs.AR(data[1:10], data[11:25])

## Obtain log Bayes factor, chains, and log interval null Bayes factor
output = ttest.Gibbs.AR(data[1:10], data[11:25], return.chains = TRUE, areaNull = c(-0.2, 0.2))

## Look at the posterior distribution of the mean
plot(output$chains[,1])

## Obtain summary statistics of posterior distributions
summary(output$chains)
```

---

ttest.MCGQ.AR *Obtain Bayesian t test for single case data*

Description

This function computes a Bayes factor for the mean difference between two phases of a single subject data sequence, using Monte Carlo integration or Gaussian quadrature.

Usage

```
ttest.MCGQ.AR(before, after, iterations = 1000, treat = NULL,
            method = "MC", r.scale = 1,
            alphaTheta = 1, betaTheta = 5)
```

Arguments

before	A vector of observations, in time order, taken in Phase 1 (e.g., before the treatment).
after	A vector of observations, in time order, taken in Phase 2 (e.g., after the treatment).
iterations	Number of Gibbs sampler iterations to perform.
treat	Vector of dummy coding, indicating Phase 1 and Phase 2; default is -.5 for Phase 1 and .5 for Phase 2.
method	Method to be used to compute the Bayes factor; "MC" is monte carlo integration, "GQ" is gaussian quadrature.
r.scale	Prior scale for delta (see Details below).
alphaTheta	The alpha parameter of the beta prior on theta (see Details below).
betaTheta	The beta parameter of the beta prior on theta (see Details below).

Details

This function computes a Bayes factor for the mean difference between two data sequences from a single subject, using monte carlo integration or Gaussian quadrature. The Bayes factor compares the null hypothesis of no true mean difference against the alternative hypothesis of a true mean difference. A Bayes factor larger than 1 supports the null hypothesis, a Bayes factor smaller than 1 supports the alternative hypothesis. Auto-correlation of the errors is modeled by a first order auto-regressive process.

A Cauchy prior is placed on the standardized mean difference delta. The `r.scale` argument controls the scale of this Cauchy prior, with `r.scale=1` yielding a standard Cauchy prior. A noninformative Jeffreys prior is placed on the variance of the random shocks of the auto-regressive process. A beta prior is placed on the auto-correlation theta. The `alphaTheta` and `betaTheta` arguments control the form of this beta prior.

Missing data are handled by removing the locations of the missing data from the design matrix and error covariance matrix.

Value

A scalar giving the monte carlo or Gaussian quadrature estimate of the log Bayes factor.

Note

To obtain posterior distributions and interval null Bayes factors, see `ttest.Gibbs.AR`.

Author(s)

Richard D. Morey and Rivka de Vries

References

De Vries, R. M. \& Morey, R. D. (submitted). Bayesian hypothesis testing Single-Subject Data. Psychological Methods.

R code guide: http://drsmorey.org/research/rdmorey/

See Also

ttest.Gibbs.AR, trendtest.Gibbs.AR, trendtest.MC.AR

Examples

```
## Define data
data = c(87.5, 82.5, 53.4, 72.3, 94.2, 96.6, 57.4, 78.1, 47.2,
 80.7, 82.1, 73.7, 49.3, 79.3, 73.3, 57.3, 31.7, 50.4, 77.8,
 67, 40.5, 1.6, 38.6, 3.2, 24.1)

## Obtain log Bayes factor
logBF = ttest.MCGQ.AR(data[1:10], data[11:25])
```

Index

∗Topic **htest**
BayesSingleSub-package, 2
trendtest.Gibbs.AR, 3
trendtest.MC.AR, 5
ttest.Gibbs.AR, 7
ttest.MCGQ.AR, 9
∗Topic **models**
trendtest.Gibbs.AR, 3
trendtest.MC.AR, 5
ttest.Gibbs.AR, 7
ttest.MCGQ.AR, 9

BayesSingleSub
(BayesSingleSub-package), 2
BayesSingleSub-package, 2

trendtest.Gibbs.AR, 3, *6*, *7*, *9*, *11*
trendtest.MC.AR, *4*, *5*, 5, *9*, *11*
ttest.Gibbs.AR, *5*, *7*, 7, *10*, *11*
ttest.MCGQ.AR, *5*, *7*, *9*, 9