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

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

Examples

## See specific functions for examples
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

```r
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. Autocorrelation 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
trendtest.MC.AR

References

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

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

Examples

```r
## 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. Autocorrelation 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


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

See Also

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

Examples

```r
## 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])
```

**Example:**

```r
## 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])
```

**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, sdmest = 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.

test.Gibbs.AR

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.
Obtain Bayesian t test for single case data

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


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


Examples

\begin{verbatim}
# 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])
\end{verbatim}
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, 9, 11
- ttest.Gibbs.AR, 5, 7, 10, 11
- ttest.MCGQ.AR, 5, 7, 9, 9