

# Package ‘bdribs’

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**Title** Bayesian Detection of Potential Risk Using Inference on Blinded Safety Data

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**Description** Implements Bayesian inference to detect signal from blinded clinical trial when total number of adverse events of special concerns and total risk exposures from all patients are available in the study. For more details see the article by Mukhopadhyay et. al. (2018) titled 'Bayesian Detection of Potential Risk Using Inference on Blinded Safety Data', in Pharmaceutical Statistics (to appear).

**Depends** R (>= 3.1.0), rjags

**Note** Package 'rjags' requires JAGS executabe file (compatible version) should be already installed.

**License** GPL-2

**RoxygenNote** 6.0.1

**NeedsCompilation** no

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bdribs	<i>bdribs (Bayesian Detection of Risk using Inference on Blinded Safety data)</i>
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## Description

Bayesian Detection of Risk using Inference on Blinded Safety data

## Usage

```
bdribs(y, pyr, bg.events, bg.pyr, bg.rate = NULL, k = 1, p.params = list(a
  = 1, b = 1), r.params = list(mu = 0, sd = 2), adj.k = FALSE,
  mc.params = list(burn = 1000, iter = 10000, nc = 2), inf.type = 1,
  plots = TRUE, prnt = TRUE)
```

## Arguments

y	observed pooled events (combined active and control group) e.g., y = 20
pyr	total payr exposure (combined active and control group) e.g., pyr = 2000
bg.events	background (historical) events for the control group e.g., bg.events = 5
bg.pyr	background (historical) pyr exposure for the control group e.g., bg.pyr = 1000
bg.rate	when specified used as the true background rate for the control group and ignores bg.events and bg.pyr, default: bg.rate=NULL
k	allocation ratio of treatment vs. control group, default: k=1
p.params	paramaters of beta prior of p (used only when inf.type = 1 or = 2); default: p.param= list(a=1,b=1). See details below.
r.params	paramaters of log-normal prior of r (used only when p.params=NULL); default: r.param= list(mu=0,sd=2). See details below.
adj.k	when TRUE adjusts the prior specification for k >1 (or for k <1), default: adj.k = FALSE . See deatil below.
mc.params	contains details of MCMC parameters, default: mc.params=list(burn=1000, iter=10000, nc=2)
inf.type	indicate inference type, default: inf.type =1 (gives conditional inference for fixed background rate). See deatil below.
plots	indicates whether standard plots to be generated, default: plots= TRUE
prnt	indicates whether inputs to be printed, default: prnt= TRUE

## Details

This 'bdribs' package obtains Bayesian inferences on blinded pooled safety data ...

Values of p.params are used to specify a beta prior for p - default is Jeffreys non-informative prior: Beta(a=0.5,b=0.5).

If `inf.type=1`, then conditional posterior inference on `r` is obtained for a given fixed values of `del0 = bg.rate = bg.events/bg.pyr`.

If `inf.type=2`, then an average (marginal) Bayesian inference on `r` is obtained with respect to a prior on `del0`, where `del0 ~ Gamma(bg.events, bg.pyr)`.

If prior on `r` must be specified directly it can be done by using a log-normal prior. To do that, `p.params` must be set to `NULL` and then `r.params` should be specified as a list to supply mean and sd of the lognormal. For example, to have a lognormal prior with log-mean 0 and log-sd = 2, we should set `r.params = list(mu=0, sd=2)` and `p.params=NULL`.

when `adj.k = TRUE`, and `k` is not 1 (that is, allocation ratio is not 1:1), then a non-informative prior such as `(beta(.5, .5))` is first specified on `p`, assuming equal allocation ratio and then adjusted for the give `k`. When `adj.k = F`, then no such adjustment is made on the prior for `p`. Note that no such adjustments needed if prior on `r` is directly specified (as discussed above). However, it is always difficult to specify a non-informative prior on `r` and therefore a a prior on `p` with `adj.k=T` is recommended in most cases.

### Value

returns a dataframe of MCMC output from the posterior distribution for parameters of interests

### Author(s)

Saurabh Mukhopadhyay

### Examples

```
## Sample calls
#run 1: simple case with a fixed background rate of 0.45 per 100 pyr.
bdribs(y=5,pyr=500, bg.rate=0.0045,k=2)

#run 2: same as run 1; here bg.rate gets computed as bg.events/bg.pyr
bdribs(y=5,pyr=500, bg.events = 18, bg.pyr = 4000, k=2)

# run3: when inf.type = 2, uses a Gamma distribution for del0; e.g. here Gamma(18, 4000)
bdribs(y=5,pyr=500, bg.events = 18, bg.pyr = 4000, k=2, inf.type = 2)

#run4: similar to run1, but instead of default p~u(0,1) using p~beta(.5,.5)
bdribs(y=5,pyr=500, , bg.rate=0.0045,k=2, p.params=list(a=.5,b=.5))

#run5: similar to run1, but instead of default p ~ beta(.5, .5) using r ~ lognormal(mu=0,sd=2)
bdribs(y=5,pyr=500, , bg.rate=0.0045,k=2, p.params= NULL, r.params=list(mu=0,sd=2))
```

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<code>bdribs.contour</code>	<i>contour plot - draws plot (optional) and returns a matrix/grid of posterior values</i>
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### Description

Contour plot of posterior probabilities on a range of (y, E) values

**Usage**

```
bdribs.contour(ymax, pyrmax, eincr, tol, k, bg.rate, plt = TRUE, ...)
```

**Arguments**

<code>ymax</code>	maximum number of AESI event for which contour plot to be drawn
<code>pyrmax</code>	maximum risk exposure (in patient-year)
<code>eincr</code>	increment of patient-year exposures (default = 50)
<code>tol</code>	the maximum tolerance value of relative risk $r$ (default = 1)
<code>k</code>	allocation ratio (T:C)
<code>bg.rate</code>	estimated background rate (historical control rate) per patient-year (using <code>inf.type=1</code> )
<code>plt</code>	whether a contour plot to be drawn (default = TRUE)
<code>...</code>	to supply remaining parameters for <code>bdribs</code> call when supplied will override the default values

**Value**

returns contour plot matrix over the grid specified

**Examples**

```
## Sample calls
#run 1: The contour plot

bdribs.contour(ymax=15,pyrmax=2000,eincr=250,tol=1.5,k=2, bg.rate=0.0045)
#run 2: Monitoring blinded AE over time using contour plot
bdribs.contour(ymax=15,pyrmax=2000,eincr=250,tol=1.5,k=2, bg.rate=0.0045)
obs.pyr=c(300,570,650,800, 1200, 1500)
obs.y=c(2,4,5,6,10,12)
points(obs.pyr, obs.y,type="p",pch=16, cex=1.4,col="maroon")
if (length(obs.y)>1) points(c(0,obs.pyr), c(0,obs.y), type="s", lty=3, lwd=2,
col="black")
```

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<code>bdribs.sensitivity</code>	<i>sensitivity plot - plot of range of posterior probability corresponding to a range of background rate</i>
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**Description**

plot of range of posterior probability corresponding to a range of background rate

**Usage**

```
bdribs.sensitivity(Y = 5:9, pyr = 800, k = 1, tol = 1.2, bg.evnt = 18,
  bg.pyr = 4000, bg.ci.coef = 0.9, bg.rng = NULL, add.mid = FALSE, ...)
```

**Arguments**

Y	range on number of AESI events for which sensitivity range to be drawn (default = 5:9)
pyr	total patient-year exposure where AESI events occurred (default =800)
k	allocation ratio (T:C) (default =1)
tol	clinically meaningful relative risk (default =1.2)
bg.evnt	background (historical) number of events in the control group (default =18)
bg.pyr	background (historical) patient-year exposure in the control group (default =4000)
bg.ci.coef	range of background rate estimate to be obtained from $bg.ci.coef * 100\%$ CI (default =0.9); takes any value between 0.5 and 0.999.
bg.rng	range of background rate - if specified then bg.evnt, bg.pyr, and bg.ci.coef will be ignored (default =NULL)
add.mid	indicator variable to plot $P(r>tol   Y, pyr)$ under $inf.type=2$ - requires related parameters to be supplied (default =F)
...	to supply remaining parameters of bdribs call (other than y, pyr, k, bg.events, bg.pyr) for bdribs call when supplied will override the default values

**Value**

returns a plot of  $P(r>tol | Y, pyr)$  over the range of background rate

**Examples**

```
## Sample calls
#run 1: The sensitivity plot
bdribs.sensitivity(Y=5:9,pyr=800,k=1, tol=1.2, bg.evnt=18, bg.pyr=4000,bg.ci.coef=0.90)
#run 2: The sensitivity plot
bdribs.sensitivity(Y=5:9,pyr=800,k=1, tol=1.2, bg.evnt=18, bg.pyr=4000,bg.ci.coef=0.90,
add.mid=TRUE)
#run 3: Using bg.rng parameter
bdribs.sensitivity(Y=5:9,pyr=800,k=1, tol=1.2, bg.rng = c(0.0030, 0.0045, 0.0065))
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