Package 'bdlim'

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Title Bayesian Distributed Lag Interaction Models

Version 0.5.0

Date 2025-06-09

Description Estimation and interpretation of Bayesian distributed lag interaction models (BDLIMs). A BDLIM regresses a scalar outcome on repeated measures of exposure and allows for modification by a categorical variable under four specific patterns of modification. The main function is bdlim(). There are also summary and plotting files. Details on methodology are described in Wilson et al. (2017) <doi:10.1093/biostatistics/kxx002>.

License GPL (>= 3)

Encoding UTF-8

Imports LaplacesDemon, ggplot2, parallel, BayesLogit

RoxygenNote 7.3.2

BugReports https://github.com/anderwilson/bdlim/issues/

URL https://anderwilson.github.io/bdlim/,
https://github.com/AnderWilson/bdlim/

Depends R (>= 2.10)

LazyData true

NeedsCompilation no

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Repository CRAN

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Contents

`bdlim1` *Fit the BDLIM model with 1 pattern of modification*

Description

Fit the BDLIM model with 1 pattern of modification

Usage

```
bdlim1(
  y,
  exposure,
  covars,
  group,
  id = NULL,
  w_free,
  b_free,
  df,
  nits,
  nburn = round(nits/2),
  nthin = 1,
  progress = TRUE
)
```

Arguments

`y`	A vector of outcomes
`exposure`	A matrix of exposures with one row for each individual
`covars`	A matrix or data.frame of covariates This should not include the grouping factor (see group below). This may include factor variables.
`group`	A vector of group memberships. This should be a factor variable.

id	An optional vector of individual IDs if there are repeated measures or other groupings that a random intercept should be included for. This must be a factor variable.
w_free	Logical indicating if the weight functions are shared by all groups (FALSE) or group-specific (TRUE).
b_free	Logical indicating if the effect sizes are shared by all groups (FALSE) or group-specific (TRUE).
df	Degrees of freedom for the weight functions
nits	Number of MCMC iterations.
nburn	Number of MCMC iterations to be discarded as burn in. The default is half if the MCMC iterations. This is only used for WAIC in this function but is passed to summary and plot functions and used there.
nthin	Thinning factors for the MCMC. This is only used for WAIC in this function but is passed to summary and plot functions and used there.
progress	Logical indicating if a progress bar should be shown during MCMC iterations. Default is TRUE.

Value

A list with posteriors of parameters

Examples

```
# run BDLIM with modification by ChildSex
fit_sex <- bdlim1(
  y = sbd_bdlim$bwgaz,
  exposure = sbd_bdlim[,paste0("pm25_",1:37)],
  covars = sbd_bdlim[,c("MomPriorBMI","MomAge","race","Hispanic",
                                  "EstMonthConcept","EstYearConcept")],
  group = as.factor(sbd_bdlim$ChildSex),
  w_free = TRUE,
  b_free = TRUE,
  df = 5,
  nits = 5000
)

# show model fit results
fit_sex

#summarize results
sfit_sex <- summary(fit_sex)
sfit_sex

# graph the estimated distributed lag functions for each group
plot(sfit_sex)


# run BDLIM with no modification
```

```
# here a single group is put in for group
# the group must be a factor
# w_free and b_free must be FALSE because modification is not allowed with only one group
fit_onegroup <- bdlim1(
  y = sbd_bdlim$bwgaz,
  exposure = sbd_bdlim[,paste0("pm25_",1:37)],
  covars = sbd_bdlim[,c("MomPriorBMI","MomAge","race","Hispanic",
                        "EstMonthConcept","EstYearConcept")],
  group = as.factor(rep("A",nrow(sbd_bdlim))),
  w_free = FALSE,
  b_free = FALSE,
  df = 5,
  nits = 5000
)

# show model fit results
fit_onegroup

#summarize results
sfit_onegroup <- summary(fit_onegroup)
sfit_onegroup

# graph the estimated distributed lag functions for the one group
plot(sfit_onegroup)

# extract the weight function
getw(fit_onegroup)
```

`bdlim1_logistic` *Fit the BDLIM model with 1 pattern of modification with logistic regression*

Description

Fit the BDLIM model with 1 pattern of modification with logistic regression

Usage

```
bdlim1_logistic(
  y,
  exposure,
  covars,
  group,
  id = NULL,
  w_free,
  b_free,
  df,
```

```
  nits,
  nburn = round(nits/2),
  nthin = 1,
  progress = TRUE
)
```

Arguments

y	A vector of binary outcomes
exposure	A matrix of exposures with one row for each individual
covars	A matrix or data.frame of covariates This should not include the grouping factor (see group below). This may include factor variables.
group	A vector of group memberships. This should be a factor variable.
id	An optional vector of individual IDs if there are repeated measures or other groupings that a random intercept should be included for. This must be a factor variable.
w_free	Logical indicating if the weight functions are shared by all groups (FALSE) or group-specific (TRUE).
b_free	Logical indicating if the effect sizes are shared by all groups (FALSE) or group-specific (TRUE).
df	Degrees of freedom for the weight functions
nits	Number of MCMC iterations.
nburn	Number of MCMC iterations to be discarded as burn in. The default is half if the MCMC iterations. This is only used for WAIC in this function but is passed to summary and plot functions and used there.
nthin	Thinning factors for the MCMC. This is only used for WAIC in this function but is passed to summary and plot functions and used there.
progress	Logical indicating if a progress bar should be shown during MCMC iterations. Default is TRUE.

Value

A list with posteriors of parameters

---

bdlim4 *Fit the BDLIM model with all 4 patterns of modification*

Description

Fit the BDLIM model with all 4 patterns of modification

Usage

```
bdlim4(
  y,
  exposure,
  covars,
  group,
  id = NULL,
  df,
  nits,
  nburn = round(nits/2),
  nthin = 1,
  parallel = FALSE,
  family = "gaussian"
)
```

Arguments

y	A vector of outcomes
exposure	A matrix of exposures with one row for each individual
covars	A matrix or data.frame of covariates This should not include the grouping factor (see group below). This may include factor variables.
group	A vector of group memberships. This should be a factor variable.
id	An optional vector of individual IDs if there are repeated measures or other groupings that a random intercept should be included for. This must be a factor variable.
df	Degrees of freedom for the weight functions
nits	Number of MCMC iterations.
nburn	Number of MCMC iterations to be discarded as burn in. The default is half if the MCMC iterations. This is only used for WAIC in this function but is passed to summary and plot functions and used there.
nthin	Thinning factors for the MCMC. This is only used for WAIC in this function but is passed to summary and plot functions and used there.
parallel	Logical to use parallel computing for 4 models. If TRUE then the min of 4 and number of cores available will be used.
family	Family of model to be used. Supported options are "gaussian" for a normal/Gaussian linear model and "binomial" for a logistic model.

Value

A list of results from each different pattern of modification and model compassion metrics

Examples

```
# run BDLIM with modification by ChildSex
fit_sex <- bdlim4(
```

```
  y = sbd_bdlim$bwgaz,
  exposure = sbd_bdlim[,paste0("pm25_",1:37)],
  covars = sbd_bdlim[,c("MomPriorBMI","MomAge","race","Hispanic",
                                  "EstMonthConcept","EstYearConcept")],
  group = as.factor(sbd_bdlim$ChildSex),
  df = 5,
  nits = 5000,
  parallel = FALSE
)

# show model comparison results
fit_sex

#summarize results
sfit_sex <- summary(fit_sex)
sfit_sex
# graph the estimated distributed lag functions for each group
plot(sfit_sex)
```

`getw` *Get weight function*

Description

Get weight function

Usage

```
getw(object, type = "normal", ...)
```

Arguments

`object`	An object of class bdlim1.
`type`	Type of summary. The default is 'normal' which returns a summary with the mean projected to conform with the norm 1 constraint. Others are `raw` which is the same as normal but without the mean projected and `full` that returns all posterior samples used in the analysis (burn in removed and thinned).
`...`	Not used.

Value

A data frame with either the summary of the weight function (types normal and raw) or a posterior sample of the weight function (type full).

makebasis *Make orthonomal basis for weight functions*

Description

Make orthonomal basis for weight functions

Usage

```
makebasis(exposure, df)
```

Arguments

exposure	Matrix of repeated measures of exposure that is n x T where n is the number of observations and T is the number of time points.
df	Degrees of freedom (including intercept) for the natural spline basis to be used.

Value

A matrix with orthonormal basis expansions of exposure time. The matrix is T x df. These have the span of natural splines with an intercept and df degrees of freedom.

Examples

```
B <- makebasis(sbd_bdlim[,paste0("pm25_",1:37)], df=4)
```

modelcompare *Model comparison for bdlim objects*

Description

Model comparison for bdlim objects

Usage

```
modelcompare(object)
```

Arguments

object	An object of class bdlim4 obtained from the bdlim4 function.

Value

A vector of model probabilities.

`plot.summary.bdlim1` *Plot for Summary of BDLIM (summary.bdlim1 version)*

Description

Plot for Summary of BDLIM (summary.bdlim1 version)

Usage

```
## S3 method for class 'summary.bdlim1'
plot(x, ...)
```

Arguments

x	An object of class summary.bdlim1.
...	Not used.

Value

An ggplot2 figure.

Examples

```
# run BDLIM with modification by ChildSex
fit_sex <- bdlim4(
  y = sbd_bdlim$bwgaz,
  exposure = sbd_bdlim[,paste0("pm25_",1:37)],
  covars = sbd_bdlim[,c("MomPriorBMI","MomAge","race","Hispanic",
                                    "EstMonthConcept","EstYearConcept")],
  group = as.factor(sbd_bdlim$ChildSex),
  df = 5,
  nits = 5000,
  parallel = FALSE
)

# show model comparison results
fit_sex

#summarize results
sfit_sex <- summary(fit_sex)

# graph the estimated distributed lag functions for each group
plot(sfit_sex)

# can save plot as an object and modify with ggplot2
library(ggplot2)
plt <- plot(sfit_sex)
plt + ggtitle("My plot with BDLIM") +
```

```
 ylab("Estimated expected difference in\nBWGAZ per 1 ug/m3 increase in exposure")

# the summary file has the data to make this plot
head(sfit_sex$dlfun)
```

`plot.summary.bdlim4` *Plot for Summary of BDLIM*

Description

Plot for Summary of BDLIM

Usage

```
## S3 method for class 'summary.bdlim4'
plot(x, ...)
```

Arguments

`x`	An object of class summary.bdlim4.
`...`	Not used.

Value

An ggplot2 figure.

Examples

```
# run BDLIM with modification by ChildSex
fit_sex <- bdlim4(
  y = sbd_bdlim$bwgaz,
  exposure = sbd_bdlim[,paste0("pm25_",1:37)],
  covars = sbd_bdlim[,c("MomPriorBMI","MomAge","race","Hispanic",
                                    "EstMonthConcept","EstYearConcept")],
  group = as.factor(sbd_bdlim$ChildSex),
  df = 5,
  nits = 5000,
  parallel = FALSE
)

# show model comparison results
fit_sex

#summarize results
sfit_sex <- summary(fit_sex)
```

```
# graph the estimated distributed lag functions for each group
plot(sfit_sex)

# can save plot as an object and modify with ggplot2
library(ggplot2)
plt <- plot(sfit_sex)
plt + ggtitle("My plot with BDLIM") +
 ylab("Estimated expected difference in\nBWGAZ per 1 ug/m3 increase in exposure")

# the summary file has the data to make this plot
head(sfit_sex$dlfun)
```

`print.bdlim1` *Print Results*

Description

Print Results

Usage

```
## S3 method for class 'bdlim1'
print(x, ...)
```

Arguments

`x`	An object of class bdlim1.
`...`	Not used.

Value

Assorted model output.

`print.bdlim4` *Print Results*

Description

Print Results

Usage

```
## S3 method for class 'bdlim4'
print(x, ...)
```

Arguments

x	An object of class bdlim4.
...	Not used.

Value

Assorted model output.

---

print.summary.bdlim4 *Print Summary of bdlim4*

Description

Print Summary of bdlim4

Usage

```
## S3 method for class 'summary.bdlim4'
print(x, ...)
```

Arguments

x	An object of class summary.bdlim4.
...	Not used.

Value

Assorted model output.

---

sbd_bdlim *Simulated Birth Data*

Description

A dataset containing simulated birth data for examples with bdlim. Add outcome and covariate data is simulated. The exposure data is real exposure data. Therefore, it has realistic correlation structure. The exposures are consistent with the date of conception variables. Each exposure is scaled by its IQR.

Usage

```
sbd_bdlim
```

Format

A data frame with 1000 rows (observations) and 202 variables:

bwgaz Outcome to be used. Simulated birth weight for gestational age z-score.

ChildSex Binary sex of child.

MomAge Continuous age in years.

GestAge Continuous estimated gestational age at birth in weeks.

MomHeightIn Continuous maternal height in inches.

MomPriorWeightLbs Continuous mothers pre-pregnancy weight in pounds.

MomPriorBMI Continuous mothers pre-pregnancy BMI.

race Categorical race.

Hispanic Binary indicator of Hispanic.

MomEdu Categorical maternal heighest educational attainment.

SmkAny Binary indicator of any smoking during pregnancy.

Marital Categorical maternal marital status.

Income Categorical income.

EstDateConcept Estimated date of conception.

EstMonthConcept Estimated month of conception.

EstYearConcept Estimated year of conception.

pm25_1 Exposure to be used. Weekly average exposure to PM2.5 in week 1 of gestation.

pm25_2 Exposure to be used. Weekly average exposure to PM2.5 in week 2 of gestation.

pm25_3 Exposure to be used. Weekly average exposure to PM2.5 in week 3 of gestation.

pm25_4 Exposure to be used. Weekly average exposure to PM2.5 in week 4 of gestation.

pm25_5 Exposure to be used. Weekly average exposure to PM2.5 in week 5 of gestation.

pm25_6 Exposure to be used. Weekly average exposure to PM2.5 in week 6 of gestation.

pm25_7 Exposure to be used. Weekly average exposure to PM2.5 in week 7 of gestation.

pm25_8 Exposure to be used. Weekly average exposure to PM2.5 in week 8 of gestation.

pm25_9 Exposure to be used. Weekly average exposure to PM2.5 in week 9 of gestation.

pm25_10 Exposure to be used. Weekly average exposure to PM2.5 in week 10 of gestation.

pm25_11 Exposure to be used. Weekly average exposure to PM2.5 in week 11 of gestation.

pm25_12 Exposure to be used. Weekly average exposure to PM2.5 in week 12 of gestation.

pm25_13 Exposure to be used. Weekly average exposure to PM2.5 in week 13 of gestation.

pm25_14 Exposure to be used. Weekly average exposure to PM2.5 in week 14 of gestation.

pm25_15 Exposure to be used. Weekly average exposure to PM2.5 in week 15 of gestation.

pm25_16 Exposure to be used. Weekly average exposure to PM2.5 in week 16 of gestation.

pm25_17 Exposure to be used. Weekly average exposure to PM2.5 in week 17 of gestation.

pm25_18 Exposure to be used. Weekly average exposure to PM2.5 in week 18 of gestation.

pm25_19 Exposure to be used. Weekly average exposure to PM2.5 in week 19 of gestation.

pm25_20 Exposure to be used. Weekly average exposure to PM2.5 in week 20 of gestation.

pm25_21 Exposure to be used. Weekly average exposure to PM2.5 in week 21 of gestation.

pm25_22 Exposure to be used. Weekly average exposure to PM2.5 in week 22 of gestation.

pm25_23 Exposure to be used. Weekly average exposure to PM2.5 in week 23 of gestation.

pm25_24 Exposure to be used. Weekly average exposure to PM2.5 in week 24 of gestation.

pm25_25 Exposure to be used. Weekly average exposure to PM2.5 in week 25 of gestation.

pm25_26 Exposure to be used. Weekly average exposure to PM2.5 in week 26 of gestation.

pm25_27 Exposure to be used. Weekly average exposure to PM2.5 in week 27 of gestation.

pm25_28 Exposure to be used. Weekly average exposure to PM2.5 in week 28 of gestation.

pm25_29 Exposure to be used. Weekly average exposure to PM2.5 in week 29 of gestation.

pm25_30 Exposure to be used. Weekly average exposure to PM2.5 in week 30 of gestation.

pm25_31 Exposure to be used. Weekly average exposure to PM2.5 in week 31 of gestation.

pm25_32 Exposure to be used. Weekly average exposure to PM2.5 in week 32 of gestation.

pm25_33 Exposure to be used. Weekly average exposure to PM2.5 in week 33 of gestation.

pm25_34 Exposure to be used. Weekly average exposure to PM2.5 in week 34 of gestation.

pm25_35 Exposure to be used. Weekly average exposure to PM2.5 in week 35 of gestation.

pm25_36 Exposure to be used. Weekly average exposure to PM2.5 in week 36 of gestation.

pm25_37 Exposure to be used. Weekly average exposure to PM2.5 in week 37 of gestation.

no2_1 Exposure to be used. Weekly average exposure to NO2 in week 1 of gestation.

no2_2 Exposure to be used. Weekly average exposure to NO2 in week 2 of gestation.

no2_3 Exposure to be used. Weekly average exposure to NO2 in week 3 of gestation.

no2_4 Exposure to be used. Weekly average exposure to NO2 in week 4 of gestation.

no2_5 Exposure to be used. Weekly average exposure to NO2 in week 5 of gestation.

no2_6 Exposure to be used. Weekly average exposure to NO2 in week 6 of gestation.

no2_7 Exposure to be used. Weekly average exposure to NO2 in week 7 of gestation.

no2_8 Exposure to be used. Weekly average exposure to NO2 in week 8 of gestation.

no2_9 Exposure to be used. Weekly average exposure to NO2 in week 9 of gestation.

no2_10 Exposure to be used. Weekly average exposure to NO2 in week 10 of gestation.

no2_11 Exposure to be used. Weekly average exposure to NO2 in week 11 of gestation.

no2_12 Exposure to be used. Weekly average exposure to NO2 in week 12 of gestation.

no2_13 Exposure to be used. Weekly average exposure to NO2 in week 13 of gestation.

no2_14 Exposure to be used. Weekly average exposure to NO2 in week 14 of gestation.

no2_15 Exposure to be used. Weekly average exposure to NO2 in week 15 of gestation.

no2_16 Exposure to be used. Weekly average exposure to NO2 in week 16 of gestation.

no2_17 Exposure to be used. Weekly average exposure to NO2 in week 17 of gestation.

no2_18 Exposure to be used. Weekly average exposure to NO2 in week 18 of gestation.

no2_19 Exposure to be used. Weekly average exposure to NO2 in week 19 of gestation.

no2_20 Exposure to be used. Weekly average exposure to NO2 in week 20 of gestation.

no2_21 Exposure to be used. Weekly average exposure to NO2 in week 21 of gestation.

no2_22 Exposure to be used. Weekly average exposure to NO2 in week 22 of gestation.

no2_23 Exposure to be used. Weekly average exposure to NO2 in week 23 of gestation.

no2_24 Exposure to be used. Weekly average exposure to NO2 in week 24 of gestation.

no2_25 Exposure to be used. Weekly average exposure to NO2 in week 25 of gestation.

no2_26 Exposure to be used. Weekly average exposure to NO2 in week 26 of gestation.

no2_27 Exposure to be used. Weekly average exposure to NO2 in week 27 of gestation.

no2_28 Exposure to be used. Weekly average exposure to NO2 in week 28 of gestation.

no2_29 Exposure to be used. Weekly average exposure to NO2 in week 29 of gestation.

no2_30 Exposure to be used. Weekly average exposure to NO2 in week 30 of gestation.

no2_31 Exposure to be used. Weekly average exposure to NO2 in week 31 of gestation.

no2_32 Exposure to be used. Weekly average exposure to NO2 in week 32 of gestation.

no2_33 Exposure to be used. Weekly average exposure to NO2 in week 33 of gestation.

no2_34 Exposure to be used. Weekly average exposure to NO2 in week 34 of gestation.

no2_35 Exposure to be used. Weekly average exposure to NO2 in week 35 of gestation.

no2_36 Exposure to be used. Weekly average exposure to NO2 in week 36 of gestation.

no2_37 Exposure to be used. Weekly average exposure to NO2 in week 37 of gestation.

so2_1 Exposure to be used. Weekly average exposure to SO2 in week 1 of gestation.

so2_2 Exposure to be used. Weekly average exposure to SO2 in week 2 of gestation.

so2_3 Exposure to be used. Weekly average exposure to SO2 in week 3 of gestation.

so2_4 Exposure to be used. Weekly average exposure to SO2 in week 4 of gestation.

so2_5 Exposure to be used. Weekly average exposure to SO2 in week 5 of gestation.

so2_6 Exposure to be used. Weekly average exposure to SO2 in week 6 of gestation.

so2_7 Exposure to be used. Weekly average exposure to SO2 in week 7 of gestation.

so2_8 Exposure to be used. Weekly average exposure to SO2 in week 8 of gestation.

so2_9 Exposure to be used. Weekly average exposure to SO2 in week 9 of gestation.

so2_10 Exposure to be used. Weekly average exposure to SO2 in week 10 of gestation.

so2_11 Exposure to be used. Weekly average exposure to SO2 in week 11 of gestation.

so2_12 Exposure to be used. Weekly average exposure to SO2 in week 12 of gestation.

so2_13 Exposure to be used. Weekly average exposure to SO2 in week 13 of gestation.

so2_14 Exposure to be used. Weekly average exposure to SO2 in week 14 of gestation.

so2_15 Exposure to be used. Weekly average exposure to SO2 in week 15 of gestation.

so2_16 Exposure to be used. Weekly average exposure to SO2 in week 16 of gestation.

so2_17 Exposure to be used. Weekly average exposure to SO2 in week 17 of gestation.

so2_18 Exposure to be used. Weekly average exposure to SO2 in week 18 of gestation.

so2_19 Exposure to be used. Weekly average exposure to SO2 in week 19 of gestation.

so2_20 Exposure to be used. Weekly average exposure to SO2 in week 20 of gestation.

so2_21 Exposure to be used. Weekly average exposure to SO2 in week 21 of gestation.

so2_22 Exposure to be used. Weekly average exposure to SO2 in week 22 of gestation.

so2_23 Exposure to be used. Weekly average exposure to SO2 in week 23 of gestation.

so2_24 Exposure to be used. Weekly average exposure to SO2 in week 24 of gestation.

so2_25 Exposure to be used. Weekly average exposure to SO2 in week 25 of gestation.

so2_26 Exposure to be used. Weekly average exposure to SO2 in week 26 of gestation.

so2_27 Exposure to be used. Weekly average exposure to SO2 in week 27 of gestation.

so2_28 Exposure to be used. Weekly average exposure to SO2 in week 28 of gestation.

so2_29 Exposure to be used. Weekly average exposure to SO2 in week 29 of gestation.

so2_30 Exposure to be used. Weekly average exposure to SO2 in week 30 of gestation.

so2_31 Exposure to be used. Weekly average exposure to SO2 in week 31 of gestation.

so2_32 Exposure to be used. Weekly average exposure to SO2 in week 32 of gestation.

so2_33 Exposure to be used. Weekly average exposure to SO2 in week 33 of gestation.

so2_34 Exposure to be used. Weekly average exposure to SO2 in week 34 of gestation.

so2_35 Exposure to be used. Weekly average exposure to SO2 in week 35 of gestation.

so2_36 Exposure to be used. Weekly average exposure to SO2 in week 36 of gestation.

so2_37 Exposure to be used. Weekly average exposure to SO2 in week 37 of gestation.

co_1 Exposure to be used. Weekly average exposure to CO in week 1 of gestation.

co_2 Exposure to be used. Weekly average exposure to CO in week 2 of gestation.

co_3 Exposure to be used. Weekly average exposure to CO in week 3 of gestation.

co_4 Exposure to be used. Weekly average exposure to CO in week 4 of gestation.

co_5 Exposure to be used. Weekly average exposure to CO in week 5 of gestation.

co_6 Exposure to be used. Weekly average exposure to CO in week 6 of gestation.

co_7 Exposure to be used. Weekly average exposure to CO in week 7 of gestation.

co_8 Exposure to be used. Weekly average exposure to CO in week 8 of gestation.

co_9 Exposure to be used. Weekly average exposure to CO in week 9 of gestation.

co_10 Exposure to be used. Weekly average exposure to CO in week 10 of gestation.

co_11 Exposure to be used. Weekly average exposure to CO in week 11 of gestation.

co_12 Exposure to be used. Weekly average exposure to CO in week 12 of gestation.

co_13 Exposure to be used. Weekly average exposure to CO in week 13 of gestation.

co_14 Exposure to be used. Weekly average exposure to CO in week 14 of gestation.

co_15 Exposure to be used. Weekly average exposure to CO in week 15 of gestation.

co_16 Exposure to be used. Weekly average exposure to CO in week 16 of gestation.

co_17 Exposure to be used. Weekly average exposure to CO in week 17 of gestation.

co_18 Exposure to be used. Weekly average exposure to CO in week 18 of gestation.

co_19 Exposure to be used. Weekly average exposure to CO in week 19 of gestation.

co_20 Exposure to be used. Weekly average exposure to CO in week 20 of gestation.

co_21 Exposure to be used. Weekly average exposure to CO in week 21 of gestation.

co_22 Exposure to be used. Weekly average exposure to CO in week 22 of gestation.

co_23 Exposure to be used. Weekly average exposure to CO in week 23 of gestation.

co_24 Exposure to be used. Weekly average exposure to CO in week 24 of gestation.

co_25 Exposure to be used. Weekly average exposure to CO in week 25 of gestation.

co_26 Exposure to be used. Weekly average exposure to CO in week 26 of gestation.

co_27 Exposure to be used. Weekly average exposure to CO in week 27 of gestation.

co_28 Exposure to be used. Weekly average exposure to CO in week 28 of gestation.

co_29 Exposure to be used. Weekly average exposure to CO in week 29 of gestation.

co_30 Exposure to be used. Weekly average exposure to CO in week 30 of gestation.

co_31 Exposure to be used. Weekly average exposure to CO in week 31 of gestation.

co_32 Exposure to be used. Weekly average exposure to CO in week 32 of gestation.

co_33 Exposure to be used. Weekly average exposure to CO in week 33 of gestation.

co_34 Exposure to be used. Weekly average exposure to CO in week 34 of gestation.

co_35 Exposure to be used. Weekly average exposure to CO in week 35 of gestation.

co_36 Exposure to be used. Weekly average exposure to CO in week 36 of gestation.

co_37 Exposure to be used. Weekly average exposure to CO in week 37 of gestation.

temp_1 Exposure to be used. Weekly average exposure to temperature in week 1 of gestation.

temp_2 Exposure to be used. Weekly average exposure to temperature in week 2 of gestation.

temp_3 Exposure to be used. Weekly average exposure to temperature in week 3 of gestation.

temp_4 Exposure to be used. Weekly average exposure to temperature in week 4 of gestation.

temp_5 Exposure to be used. Weekly average exposure to temperature in week 5 of gestation.

temp_6 Exposure to be used. Weekly average exposure to temperature in week 6 of gestation.

temp_7 Exposure to be used. Weekly average exposure to temperature in week 7 of gestation.

temp_8 Exposure to be used. Weekly average exposure to temperature in week 8 of gestation.

temp_9 Exposure to be used. Weekly average exposure to temperature in week 9 of gestation.

temp_10 Exposure to be used. Weekly average exposure to temperature in week 10 of gestation.

temp_11 Exposure to be used. Weekly average exposure to temperature in week 11 of gestation.

temp_12 Exposure to be used. Weekly average exposure to temperature in week 12 of gestation.

temp_13 Exposure to be used. Weekly average exposure to temperature in week 13 of gestation.

temp_14 Exposure to be used. Weekly average exposure to temperature in week 14 of gestation.

temp_15 Exposure to be used. Weekly average exposure to temperature in week 15 of gestation.

temp_16 Exposure to be used. Weekly average exposure to temperature in week 16 of gestation.

temp_17 Exposure to be used. Weekly average exposure to temperature in week 17 of gestation.

temp_18 Exposure to be used. Weekly average exposure to temperature in week 18 of gestation.

temp_19 Exposure to be used. Weekly average exposure to temperature in week 19 of gestation.

temp_20 Exposure to be used. Weekly average exposure to temperature in week 20 of gestation.

temp_21 Exposure to be used. Weekly average exposure to temperature in week 21 of gestation.

temp_22 Exposure to be used. Weekly average exposure to temperature in week 22 of gestation.

temp_23 Exposure to be used. Weekly average exposure to temperature in week 23 of gestation.

temp_24 Exposure to be used. Weekly average exposure to temperature in week 24 of gestation.

temp_25 Exposure to be used. Weekly average exposure to temperature in week 25 of gestation.

temp_26 Exposure to be used. Weekly average exposure to temperature in week 26 of gestation.

temp_27 Exposure to be used. Weekly average exposure to temperature in week 27 of gestation.

temp_28 Exposure to be used. Weekly average exposure to temperature in week 28 of gestation.

temp_29 Exposure to be used. Weekly average exposure to temperature in week 29 of gestation.

temp_30 Exposure to be used. Weekly average exposure to temperature in week 30 of gestation.

temp_31 Exposure to be used. Weekly average exposure to temperature in week 31 of gestation.

temp_32 Exposure to be used. Weekly average exposure to temperature in week 32 of gestation.

temp_33 Exposure to be used. Weekly average exposure to temperature in week 33 of gestation.

temp_34 Exposure to be used. Weekly average exposure to temperature in week 34 of gestation.

temp_35 Exposure to be used. Weekly average exposure to temperature in week 35 of gestation.

temp_36 Exposure to be used. Weekly average exposure to temperature in week 36 of gestation.

temp_37 Exposure to be used. Weekly average exposure to temperature in week 37 of gestation.

source Variable indicating that the data came from the bdlim package.

`summary.bdlim1` *Summary for bdlim1*

Description

Summary for bdlim1

Usage

```
## S3 method for class 'bdlim1'
summary(object, ...)
```

Arguments

`object`	An object of class bdlim1.
`...`	Not used.

Value

An object of class summary.bdlim1.

summary.bdlim4 *Summary for bdlim4*

Description

Summary for bdlim4

Usage

```
## S3 method for class 'bdlim4'
summary(object, model = NULL, ...)
```

Arguments

object	An object of class bdlim4.
model	Pattern of heterogeneity to be printed. If not specified (default) the best fitting model will be used. Options are "n", "b", "w" and "bw" where b indicates the effect sizes are subgroup specific and w indicates the weight functions are subgroups specific.
...	Other arguments

Value

An object of class summary.bdlim4.

Examples

```
# run BDLIM with modification by ChildSex
fit_sex <- bdlim4(
  y = sbd_bdlim$bwgaz,
  exposure = sbd_bdlim[,paste0("pm25_",1:37)],
  covars = sbd_bdlim[,c("MomPriorBMI","MomAge","race","Hispanic",
                                    "EstMonthConcept","EstYearConcept")],
  group = as.factor(sbd_bdlim$ChildSex),
  df = 5,
  nits = 5000,
  parallel = FALSE
)

#summarize results
summary(fit_sex)

# obtain estimates of the distributed lag function
# these are note displayed when printed but available for use
sfit_sex <- summary(fit_sex)
head(sfit_sex$dlfun)
```

```
# can summarize with a specific model
sfit_hisp_n <- summary(fit_sex, model="n") # no modification
sfit_hisp_b <- summary(fit_sex, model="b") # subgroup-specific effects (beta)
sfit_hisp_w <- summary(fit_sex, model="w") # subgroup-specific weight function
sfit_hisp_bw <- summary(fit_sex, model="bw") # both subgroup-specific
```

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