Package 'RegDDM'

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Title Generalized Linear Regression with DDM

Version 1.1

Description Drift-Diffusion Model (DDM) has been widely used to model binary decision-making tasks, and many research studies the relationship between DDM parameters and other characteristics of the subject. This package uses 'RStan' to perform generalized liner regression analysis over DDM parameters via a single Bayesian Hierarchical model. Compared to estimating DDM parameters followed by a separate regression model, 'RegDDM' reduces bias and improves statistical power.

License GPL (>= 3)

Encoding UTF-8

RoxygenNote 7.3.2

URL https://github.com/biorabbit/RegDDM

BugReports https://github.com/biorabbit/RegDDM/issues

Imports rstan, stringr, dplyr, tidyr, purrr, rtdists, rlang, stats,

Suggests testthat (>= 3.0.0)

Config/testthat/edition 3

Depends R (>= 3.5)

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Contents

`generate_sim_data` *Generate simulated binary decision data using DDM*

Description

This function generates a simulated dataset under different configurations It can be used to test the performance and functionality of **RegDDM**. The outcome variable is `y`, which is influenced by different variables.

Usage

```
generate_sim_data(
  N = 30,
  n_each = 100,
  n_xvar = 2,
  beta_0 = 0,
  beta_c1 = 0,
  beta_c2 = 0,
  beta_v_0 = 0,
  beta_v_x1 = 0,
  beta_v_x2 = 0,
  sigma_y = 1,
  sigma_v = 0,
  y_family = "gaussian"
)
```

Arguments

`N`	Number of subjects.
`n_each`	Number of trials per subject
`n_xvar`	Number of trial-level variables influencing drift rate
`beta_0`	Intercept
`beta_c1`	Slope of c1
`beta_c2`	Slope of c2
`beta_v_0`	Slope of v_0
`beta_v_x1`	Slope of v_x1
`beta_v_x2`	Slope of v_x2

sigma_y	Standard deviation of error term of y, Only used when y_family is "gaussian"
sigma_v	Contaminant level for drift rate v.
y_family	Family of distribution of y. Can be either "gaussian", "bernoulli" or "poisson"

Value

A named list with four elements. data1_true and data2_true are true values of DDM parameters of each subject and trial. data1 and data2 removed those hidden variables.

Examples

```
sim_data = generate_sim_data()
sim_data$data1
sim_data$data2
```

---

get_stan_fit *Get the rstan fit of regddmfit objects*

Description

Get the stanfit object of the regddmfit object to perform further analysis and diagnosis.

Usage

```
get_stan_fit(fit)
```

Arguments

fit	A regddmfit object to summary

Value

A stanfit object.

print.regddmfit *Printed summary of* **RegDDM** *fit object*

Description

Summarize the posterior distributions of estimated regression coefficients and print necessary information.

Usage

```
## S3 method for class 'regddmfit'
print(x, digits = 3, ...)
```

Arguments

x	An regddmfit object to print
digits	digits of the output results. Default value is 3.
...	Unused...

Value

No values are returned.

See Also

summary.regddmfit Table summaries of the regddmfit object.

regddm *Bayesian hierarchical generalized linear regression using Drift-Diffusion Model*

Description

regddm makes it easy to fit a single Bayesian hierarchical drift-diffusion model (DDM) that estimates the DDM parameters of each subject and uses the estimated parameters as variables in a generalized linear regression.

Usage

```
regddm(
  data1,
  data2,
  model = list(),
  family = "gaussian",
  init = "default",
  prior = TRUE,
  stan_filename = "",
  gen_model = TRUE,
  fit_model = TRUE,
  warmup = 500,
  iter = 1000,
  chains = 4,
  cores = 4,
  ...
)
```

Arguments

data1	Subject-level dataframe with column such as age and gender. It must contain an `id` column unique for each subject.
data2	Trial-level dataframe. It must contain three columns: `id`, `response` and `rt`. It can also contain additional trial-level variables such as experiment condition.
model	A list containing 0-5 formulas, specifying the dependence structure between variables.
family	Family of distribution of `y`. Can be `gaussian`, `bernoulli` or `poisson`.
init	Either `default` or other values supported by `stan` function of **RStan**
prior	A logistic value, specifying whether or not to use default prior for DDM parameters. By default, `prior` = TRUE.
stan_filename	A string specifying the automatically generated `stan` file name. By default, an empty string `''` is provided. A temporary file will be created and deleted after the model is fit.
gen_model	A logistic value indicating weather or not to generate the model. If not, RegDDM will not generate the code but use the existing `stan` code from `stan_filename` instead.
fit_model	A logistic value indicating weather or not to fit the model. If not, RegDDM will only generate the code and return an unfitted `regddmfit` object.
warmup	Number of warm-up iterations. Default is 500.
iter	Number of iterations, which must be greater than `warmup`. Default value is 1000.
chains	Number of chains to run for diagnosis. Default value is 4.
cores	Number of cores to run the chains. It is best to make `cores` = `chains`. Default value is 4.
...	Other parameters sent to `stan` function of **RStan**.

Value

A regddmfit object.

References

To be added

Examples

```
# Note: each example takes about 20 minutes to run. During this period, you
# may not be able to open/save files or see the progress. To prevent this,
# it is recommended to copy, paste and run the example code in the console.

## Not run:
# Example analysis over the synthetic dataset.
data(regddm_data)
model = list(v ~ memload, iq ~ v_memload + v_0 + age + education)
regddm(
  regddm_data$data1,
  regddm_data$data2,
  model
)

# Alternatively, subjects' DDM parameters can be used as the outcome.
model = list(v ~ memload, v_memload ~ gender)
regddm(
  regddm_data$data1,
  regddm_data$data2,
  model
)

## End(Not run)
```

---

regddmfit *Class of models fitted by* **RegDDM**

Description

regddmfit is an S3 object storing the fitted models of **RegDDM**. It contains information used to fit the model and the resulting stanfit and can be summarized and printed using summary and print.

Usage

```
regddmfit(data1, data2, model, family, stan_fit)
```

Arguments

data1	Subject-level data frame.
data2	Trial-level data frame.
model	A list containing 0-5 formulas, specifying the dependence structure between variables.
family	Family of distribution of the outcome.
stan_fit	Fitted stan model.

Details

Use methods(class = "regddmfit") for a list of available methods.

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regddm_data *Simulated dataset from from Cognitive Reserve Study.*

Description

The Cognitive Reserve study is an ongoing longitudinal study to identify neural implementations of cognitive reserve. Due to data sharing agreement, the original dataset cannot be uploaded. This is a synthetic dataset from the study. The dataset consists of two data frames. data1 is the subject-level dataset which includes the id, NART-iq, age, gender, race and education of the subjects. data2 is the trial-level data frame with the subject id, memory load, response (correct = 1) and reaction time (in seconds) of the subject.

Usage

```
regddm_data
```

Format

An object of class list of length 2.

References

Steffener, J., Brickman, A. M., Rakitin, B. C., Gazes, Y., & Stern, Y. (2009). The impact of age-related changes on working memory functional activity. *Brain Imaging and Behavior*, 3, 142–153.

summary.regddmfit *Summary of* **RegDDM** *fit object*

Description

Summarize the posterior distributions of estimated parameters and group them into four categories.

Usage

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

Arguments

object	A regddmfit object to summary
...	parameters passed to summary,stanfit-method

Value

The summary method returns a named list of glm_coefficiets, subject_ddm_param, group_param, and missing_value. Each element is a tibble data frame of posterior summary statistics of the regression coefficient, DDM parameter of each subject, group mean and standard deviation of DDM parameters and covariates, plus the estimated missing values.

See Also

print.regddmfit a printed summary of the regddmfit object.

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