Package 'qbrms'

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Title Quick Bayesian Regression Models Using 'INLA' with 'brms'

Version 0.9

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Description Provides a brms-like interface for fitting Bayesian regression models using INLA (Integrated Nested Laplace Approximations). The package offers faster model fitting while maintaining familiar brms syntax and output formats. Supports fixed and mixed effects models, multiple probability distributions, conditional effects plots, and posterior predictive checks with summary methods compatible with brms. Methods are based on Rue et al. (2009) <doi:10.1111/j.1467-9868.2008.00700.x> ``Approximate Bayesian inference for latent Gaussian models by using integrated nested Laplace approximations", BÃ¼rkner (2017) <doi:10.18637/jss.v080.i01> ``brms: An R Package for Bayesian Multilevel Models using Stan", and Kruschke (2014, ISBN:9780124058880) ``Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan".

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Imports stats, utils, MASS, quantreg

Suggests INLA (>= 22.05.07), brms (>= 2.19.0), ggplot2, testthat (>= 3.0.0), rmarkdown, sn, knitr, methods

URL https://github.com/Tony-Myers/qbrms

BugReports https://github.com/Tony-Myers/qbrms/issues

Additional_repositories https://inla.r-inla-download.org/R/stable

NeedsCompilation no

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Contents

`qbrms-package` *qbrms: Quick Bayesian Regression Models using INLA*

Description

The qbrms package provides a brms-like interface for fitting Bayesian regression models using INLA (Integrated Nested Laplace Approximations). It offers faster model fitting while maintaining familiar brms syntax and output formats.

Details

The main function is `qbrms` which fits Bayesian models using INLA with brms-like syntax. The package supports:

- Fixed and mixed effects models
- Multiple probability distributions
- Conditional effects plots
- Posterior predictive checks
- Summary methods compatible with brms

Author(s)

Tony Myers

See Also

Useful links:

- https://github.com/Tony-Myers/qbrm
- Report bugs at https://github.com/Tony-Myers/qbrm/issues

`conditional_effects` *Conditional Effects for qbrms Models*

Description

Generic function for computing conditional effects

Usage

```
conditional_effects(object, ...)
```

Arguments

`object`	Model object
`...`	Additional arguments

Value

Object of class "brms_conditional_effects"

`conditional_effects.qbrms_fit` *Conditional Effects for qbrms Models*

Description

Compute conditional effects for qbrms model objects, similar to brms.

Usage

```
## S3 method for class 'qbrms_fit'
conditional_effects(
  object,
  effects = NULL,
  conditions = NULL,
  resolution = 100,
  prob = 0.95,
  method = "fitted",
  re_formula = NULL,
  spaghetti = FALSE,
  ndraws = 100,
  ribbon = TRUE,
  ...
)
```

Arguments

`object`	A qbrms model object
`effects`	Character vector specifying effects to plot. If NULL, plots all numeric predictors.
`conditions`	Named list of values for conditional variables
`resolution`	Integer specifying number of prediction points
`prob`	Probability for credible intervals (default 0.95)
`method`	Method for generating predictions ("fitted" is default)
`re_formula`	Formula for random effects (currently ignored)
`spaghetti`	Logical, whether to add spaghetti plots
`ndraws`	Number of posterior draws for spaghetti plots
`ribbon`	Logical, whether to show ribbon (confidence band)
`...`	Additional arguments

Value

Object of class "brms_conditional_effects"

convert_binomial_formula

Convert Binomial Formulas Using 'trials()' Syntax

Description

Convert Binomial Formulas Using 'trials()' Syntax

Usage

```
convert_binomial_formula(formula, data, formula_info, verbose = TRUE)
```

create_dummy_data_for_priors

Create Dummy Data for Prior Predictive Checks

Description

Internal function to create dummy data that preserves structure.

Usage

```
create_dummy_data_for_priors(
  formula,
  data,
  n_dummy,
  family_name,
  verbose = TRUE
)
```

Arguments

formula	Model formula.
data	Original data.
n_dummy	Number of dummy observations.
family_name	The name of the model family (e.g., "poisson").
verbose	Logical, whether to print messages.

Value

Data frame with dummy structure.

create_quantile_fit *Create A Quantile Regression Fitted Object for 'INLA'*

Description

Create A Quantile Regression Fitted Object for 'INLA'

Usage

```
create_quantile_fit(formula, data, quantile = 0.5, verbose = TRUE)
```

extract_family_name *Extract Family Name from INLA Family Object*

Description

Helper function to extract family name handling both strings and lists.

Usage

```
extract_family_name(inla_family)
```

Arguments

inla_family	INLA family specification (string or list).

Value

Character string with family name.

extract_model_metrics *Extract Model Metrics*

Description

Extract DIC, WAIC and other metrics from an INLA fit.

Usage

```
extract_model_metrics(inla_fit)
```

Arguments

inla_fit	INLA model object.

Value

A list of metrics.

extract_ordinal_info *Extract Ordinal Information from Family*

Description

Extract ordinal-specific information from a family specification.

Usage

```
extract_ordinal_info(inla_family)
```

Arguments

inla_family	INLA family specification.

Value

List with ordinal information or NULL.

fit_fixed_effects_model_improved *Fit Fixed Effects Model Using INLA*

Description

Fit Fixed Effects Model Using INLA

Usage

```
fit_fixed_effects_model_improved(
  formula,
  data,
  inla_family,
  control.compute,
  verbose = TRUE,
  ...
)
```

`fit_mixed_effects_model_improved` *Fit Mixed Effects Model Using INLA*

Description

Fit Mixed Effects Model Using INLA

Usage

```
fit_mixed_effects_model_improved(
  formula,
  data,
  inla_family,
  control.compute,
  verbose = TRUE,
  ...
)
```

`fit_ordinal_model_improved` *Fit Ordinal Models Using Augmented Poisson Method in INLA*

Description

Fit Ordinal Models Using Augmented Poisson Method in INLA

Usage

```
fit_ordinal_model_improved(
  formula,
  data,
  inla_family,
  control.compute,
  verbose = TRUE,
  ...
)
```

format_duration *Format Duration*

Description

Format duration in seconds to a human-readable string.

Usage

```
format_duration(seconds)
```

Arguments

seconds	Numeric duration in seconds.

Value

Character string with formatted duration.

generate_posterior_predictive_samples *Generate posterior predictive samples*

Description

Generate posterior predictive samples

Usage

```
generate_posterior_predictive_samples(object, ndraws = 100)
```

generate_prior_predictions_simple *Generate Prior Predictions (Simple)*

Description

Generate predictions from a prior-emphasised model fit.

Usage

```
generate_prior_predictions_simple(
  model,
  data,
  formula,
  family_name,
  ndraws,
  n_cats = NULL
)
```

Arguments

model	INLA model object.
data	Original data.
formula	Original formula.
family_name	Model family name (string).
ndraws	Number of draws.
n_cats	The number of categories for an ordinal response.

Value

List with yrep matrix and observed y.

---

generate_prior_samples

Generate Prior Predictive Samples

Description

Internal helper to generate samples from the prior predictive distribution.

Usage

```
generate_prior_samples(
  formula,
  data,
  family = gaussian(),
  prior = NULL,
  ndraws = 100,
  verbose = TRUE,
  ...
)
```

Arguments

formula	Model formula.
data	Data frame.
family	Model family.
prior	Prior specifications.
ndraws	Number of draws.
verbose	Logical; print progress.
...	Additional args.

Value

Matrix of prior predictive samples.

get_predictor_variables *Get Predictor Variables from Formula*

Description

Extract predictor variables from formula, categorised by type

Usage

```
get_predictor_variables(formula, data)
```

Arguments

formula	Model formula
data	Data frame

Value

List with predictor variable information

get_random_effects_sd_summary *Get Random Effects Standard Deviation Summary*

Description

Extract random effects standard deviation from INLA hyperparameters.

Usage

```
get_random_effects_sd_summary(inla_fit, group_var)
```

Arguments

inla_fit	INLA model object.
group_var	Group variable name.

Value

List with mean, sd, and quantiles of random effects SD.

grapes-or-or-grapes *Null Coalescing Operator*

Description

Returns the first non-NULL value.

Usage

```
x %||% y
```

Arguments

x	First value.
y	Second value.

Value

x if not NULL, otherwise y.

handle_missing_data *Handle Missing Data*

Description

Process missing data in model variables, similar to brms handling.

Usage

```
handle_missing_data(formula, data, verbose = TRUE)
```

Arguments

formula	Model formula.
data	Data frame.
verbose	Logical, whether to print messages.

Value

Data frame with complete cases for model variables.

model_fitting *Model Fitting Functions for qbrms Package*

Description

Internal functions for Bayesian model fitting using INLA

Details

This file contains the core model fitting functionality for the qbrms package

parse_brms_formula *Parse brms Formula Objects*

Description

Parse brms formula objects including bf() specifications

Usage

```
parse_brms_formula(formula)
```

Arguments

formula	Formula or brms formula object

Value

List with parsed formula information

parse_formula_components *Parse Formula Components*

Description

Parse formula to identify random effects, binomial trials, etc.

Usage

```
parse_formula_components(formula, data)
```

Arguments

formula	Model formula
data	Data frame

Value

List with formula components information

plot.brms_conditional_effects *Plot Conditional Effects*

Description

Plot method for conditional effects from qbrms models.

Usage

```
## S3 method for class 'brms_conditional_effects'
plot(
  x,
  ask = TRUE,
  spaghetti_args = list(),
  line_args = list(),
  ribbon = TRUE,
  ribbon_args = list(),
  ...
)
```

Arguments

x	Object of class "brms_conditional_effects"
ask	Logical, whether to ask before showing each plot
spaghetti_args	List of arguments for spaghetti plot appearance
line_args	List of arguments for main line appearance
ribbon	Logical, whether to show confidence ribbon
ribbon_args	List of arguments for ribbon appearance
...	Additional arguments passed to ggplot2

Value

List of ggplot objects (returned invisibly)

pp_check *Posterior and Prior Predictive Checks (generic)*

Description

Generic function for posterior and prior predictive checks.

Usage

```
pp_check(object, ...)
```

Arguments

object	A model object.
...	Additional arguments passed on to methods.

Value

If **ggplot2** is available, a ggplot object is returned for posterior checks, and a proxied ggplot for prior checks whose print() emits one character of console output. Without **ggplot2**, lightweight objects are returned that draw using base graphics; the prior variant also emits one character of console output on print().

---

pp_check.qbrms_fit *Posterior Predictive Checks for qbrms models*

Description

Posterior Predictive Checks for qbrms models

Usage

```
## S3 method for class 'qbrms_fit'
pp_check(object, type = "dens_overlay", ndraws = 100, seed = NULL, ...)
```

Arguments

object	A qbrms_fit model object.
type	One of "dens_overlay", "hist", "scatter", or "scatter_avg".
ndraws	Number of predictive draws to use where relevant.
seed	Random seed for reproducibility.
...	Unused.

Value

See pp_check.

---

pp_check.qbrms_prior *Prior Predictive Checks for qbrms prior objects*

Description

Prior Predictive Checks for qbrms prior objects

Usage

```
## S3 method for class 'qbrms_prior'
pp_check(object, type = "dens_overlay", ndraws = 100, seed = NULL, ...)
```

Arguments

object	A qbrms_fit model object.
type	One of "dens_overlay", "hist", "scatter", or "scatter_avg".
ndraws	Number of predictive draws to use where relevant.
seed	Random seed for reproducibility.
...	Unused.

Value

See pp_check.

---

print.ordinal_augmented_qbrms_fit

Print Method for Augmented Ordinal Models

Description

Print method for augmented ordinal model objects.

Usage

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

Arguments

x	An ordinal_augmented_qbrms_fit object.
...	Additional arguments.

Value

The object invisibly, after printing.

---

print.ordinal_binary_qbrms_fit

Print Method for Binary Decomposition Ordinal Models

Description

Print method for binary decomposition ordinal model objects.

Usage

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

Arguments

x	An ordinal_binary_qbrms_fit object.
...	Additional arguments.

Value

The object invisibly, after printing.

---

print.qbrms_fit *Print Method for qbrms Models*

Description

Print method for qbrms model objects.

Usage

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

Arguments

x	A qbrms_fit model object.
...	Additional arguments (currently ignored).

Value

The object invisibly, after printing.

---

qbrms *Main q-brms model fitting interface (simplified example)*

Description

Fit Bayesian models using INLA with a syntax similar to brms. Supports various model families including Gaussian, binomial, Poisson, ordinal, and quantile regression models.

Usage

```
qbrms(
  formula,
  data,
  family = gaussian(),
  prior = NULL,
  sample_prior = "no",
  quantile = 0.5,
  control.compute = list(dic = TRUE, waic = TRUE, cpo = TRUE),
  verbose = TRUE,
  ...
```

```
)

qbrms(
  formula,
  data,
  family = gaussian(),
  prior = NULL,
  sample_prior = "no",
  quantile = 0.5,
  control.compute = list(dic = TRUE, waic = TRUE, cpo = TRUE),
  verbose = TRUE,
  ...
)
```

Arguments

formula	A model formula specifying the model structure. Use standard R formula syntax, with support for random effects using the (1 | group) syntax and binomial trials using response | trials(n) ~ predictors.
data	A data frame containing all variables in the formula.
family	A family object specifying the response distribution and link function. Options include gaussian(), binomial(), poisson(), cumulative(), asymmetric_laplace(), etc. Defaults to gaussian().
prior	Prior specification for model parameters. Currently not fully implemented - INLA defaults are used.
sample_prior	If "only", generate samples from the prior predictive distribution instead of fitting the model. If "no" (default), fit the model normally.
quantile	For quantile regression (when family = asymmetric_laplace()), the quantile level to estimate. Should be between 0 and 1. Defaults to 0.5 (median regression).
control.compute	A list of control parameters passed to INLA for computation options. Defaults include DIC, WAIC, and CPO calculation.
verbose	Logical; if TRUE (default), print progress information during model fitting.
...	Additional arguments passed to the underlying INLA fitting function.

Details

This function provides a brms-like interface to INLA for Bayesian model fitting. It automatically detects the model type based on the formula and family, and uses appropriate INLA formulations.

Value

An object of class qbrms_fit containing:

- fit: The fitted INLA model object
- original_formula: The model formula
- data: The data used for fitting
- family: The model family specification
- model_type: Type of model fitted
- fitting_time: Time taken to fit the model

See Also

qmbs, pp_check

Examples

```
## Not run:
# Simple linear regression
fit1 <- qbrms(y ~ x, data = data, family = gaussian())

# Mixed effects model
fit2 <- qbrms(y ~ x + (1 | group), data = data, family = gaussian())

# Quantile regression
fit3 <- qbrms(y ~ x, data = data, family = asymmetric_laplace(), quantile = 0.9)

# Prior predictive check
fit_prior <- qbrms(y ~ x, data = data, sample_prior = "only")

## End(Not run)
```

---

qmbs *Fit Bayesian Models using qbrms (Alternative Interface)*

Description

Alternative interface to qbrms with a shorter name. This function provides the same functionality as qbrms.

Usage

```
qmbs(
  formula,
  data,
  family = gaussian(),
  prior = NULL,
  sample_prior = "no",
  quantile = 0.5,
  control.compute = list(dic = TRUE, waic = TRUE, cpo = TRUE),
  verbose = TRUE,
  ...
)
```

Arguments

formula	A model formula specifying the model structure.
data	A data frame containing the variables in the model.
family	A family object or character string specifying the response distribution. Defaults to gaussian().
prior	Prior specification (currently not implemented).
sample_prior	If "only", generate prior predictive samples instead of fitting the model.

quantile	Quantile level for quantile regression (when family is asymmetric_laplace).
control.compute	A list of control parameters for INLA computation.
verbose	Logical; if TRUE, print progress information.
...	Additional arguments passed to INLA.

Value

An object of class qbrms_fit containing the fitted model.

See Also

qbrms

Examples

```
## Not run:
# Simple linear regression
fit <- qmbs(y ~ x, data = data, family = gaussian())

# Prior predictive check
fit_prior <- qmbs(y ~ x, data = data, sample_prior = "only")

## End(Not run)
```

---

quantile_regression_fit

Quantile Regression Using 'quantreg' Package

Description

Quantile Regression Using 'quantreg' Package

Usage

```
quantile_regression_fit(formula, data, quantile = 0.5, verbose = TRUE)
```

---

requires_special_handling

Check if Family Requires Special Handling

Description

Check if a family specification requires the data augmentation method.

Usage

```
requires_special_handling(inla_family)
```

Arguments

inla_family	INLA family specification.

Value

Logical indicating if special handling is needed.

---

summary.ordinal_augmented_qbrms_fit
Summary Method for Augmented Ordinal Models

Description

Summary method for ordinal models fitted using data augmentation.

Usage

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

Arguments

object	An ordinal_augmented_qbrms_fit object.
...	Additional arguments.

Value

The object invisibly, after printing the summary.

---

summary.ordinal_binary_qbrms_fit
Summary Method for Binary Decomposition Ordinal Models

Description

Summary method for ordinal models fitted using binary decomposition.

Usage

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

Arguments

object	An ordinal_binary_qbrms_fit object.
...	Additional arguments.

Value

The object invisibly, after printing summary.

summary.ordinal_qbrms_fit *Summary for General Ordinal qbrms Fits*

Description

Generic summary method for ordinal qbrms fits.

Usage

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

Arguments

object	An ordinal_qbrms_fit object.
...	Additional arguments.

summary.qbrms_fit *Summary Method for qbrms Models*

Description

Provides brms-style summary output for qbrms model fits.

Usage

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

Arguments

object	A qbrms_fit model object.
...	Additional arguments (currently ignored).

Value

The object invisibly, after printing summary.

vcov.inla *Variance-Covariance Matrix for INLA Objects*

Description

Extract the variance-covariance matrix from an INLA fit object.

Usage

```
## S3 method for class 'inla'
vcov(object, ...)

## S3 method for class 'inla'
vcov(object, ...)
```

Arguments

object	An INLA fit object.
...	Additional arguments (currently unused).

Value

A variance-covariance matrix for the fixed effects.

vcov.quantile_inla *Variance-Covariance Matrix for Quantile INLA Objects*

Description

Extract the variance-covariance matrix from a quantile INLA fit object.

Usage

```
## S3 method for class 'quantile_inla'
vcov(object, ...)

## S3 method for class 'quantile_inla'
vcov(object, ...)
```

Arguments

object	A quantile_inla fit object.
...	Additional arguments (currently unused).

Value

A variance-covariance matrix for the fixed effects.