

Package ‘BDPTobitQR’

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Title Bayesian Double-Penalty Tobit Quantile Regression for
Longitudinal Interval-Censored Data

Version 0.1.0

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Description Implements Bayesian Double-Penalty Tobit Quantile Regression methods for longitudinal interval-censored data as proposed by Zhao et al. (2024) <[doi:10.3390/math12121782](https://doi.org/10.3390/math12121782)>. Supports Bayesian Tobit quantile regression with double adaptive Lasso penalty ('PDAL-BTQR'), double Lasso penalty ('PDL-BTQR'), and unpenalized mixed-effects ('P-BTQR'). Handles left, right, interval, and bilateral censoring schemes in longitudinal and clustered structures. Includes Gibbs sampling algorithms, parameter estimation, standard error computation, posterior credible intervals, forecast predictions, DIC, LPML, and diagnostic plotting. References: Tobin (1958) <[doi:10.2307/1907382](https://doi.org/10.2307/1907382)>; Koenker and Bassett (1978) <[doi:10.2307/1913643](https://doi.org/10.2307/1913643)>; Zou (2006) <[doi:10.1198/016214506000000735](https://doi.org/10.1198/016214506000000735)>; Alhamzawi and Yu (2012) <[doi:10.1016/j.csda.2011.11.018](https://doi.org/10.1016/j.csda.2011.11.018)>; Zhao et al. (2024) <[doi:10.3390/math12121782](https://doi.org/10.3390/math12121782)>.

License GPL (>= 3)

Encoding UTF-8

LazyData true

Depends R (>= 4.0.0)

Imports stats, graphics, grDevices

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BDPTobitQR-package	<i>Bayesian Double-Penalty Tobit Quantile Regression for Longitudinal Interval-Censored Data</i>
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Description

Implements Bayesian Double-Penalty Tobit Quantile Regression methods for longitudinal interval-censored data as proposed by Zhao et al. (2024). Supports double adaptive Lasso ('PDAL-BTQR'), double Lasso ('PDL-BTQR'), and unpenalized mixed-effects ('P-BTQR').

Details

Package:	BDPTobitQR
Type:	Package
Version:	0.1.0
Date:	2026-07-28
License:	GPL (>= 3)
LazyData:	true

The main entry point is [bdp_tobit_qr](#).

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References

Zhao, K., Shu, T., Hu, C., and Luo, Y. (2024). Research on Quantile Regression Method for Longitudinal Interval-Censored Data Based on Bayesian Double Penalty. *Mathematics*, 12(12), 1782. [doi:10.3390/math12121782](https://doi.org/10.3390/math12121782)

bdp_tobit_qr	<i>Bayesian Double-Penalty Tobit Quantile Regression for Longitudinal Interval-Censored Data</i>
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Description

Fits Bayesian Tobit quantile regression models for longitudinal or clustered interval-censored data using double adaptive Lasso penalty ('PDAL-BTQR'), double Lasso penalty ('PDL-BTQR'), or unpenalized mixed-effects ('P-BTQR') as proposed by Zhao et al. (2024).

Usage

```
bdp_tobit_qr(
  formula,
  random = ~1,
  data,
  id,
  lower = -Inf,
  upper = Inf,
  tau = 0.5,
  method = c("PDAL-BTQR", "PDL-BTQR", "P-BTQR"),
  n_iter = 5000,
  burn_in = 1000,
  thin = 1,
  hyperparams = list(
    e0 = 0.1, f0 = 0.1,
    g0 = 0.1, h0 = 0.1,
    c0 = 0.001, d0 = 0.001
  ),
  verbose = FALSE
)
```

Arguments

formula	Object of class formula describing the fixed-effects part of the model.
random	Formula or design matrix describing the random-effects part of the model. Default is ~1.
data	Data frame containing the variables in the model.
id	Vector or column name in data identifying clusters or subjects.
lower	Lower censoring limit or vector of lower limits. Default is -Inf.
upper	Upper censoring limit or vector of upper limits. Default is Inf.
tau	Quantile level between 0 and 1. Default is 0.5.
method	Fitting method: "PDAL-BTQR" (double adaptive Lasso), "PDL-BTQR" (double Lasso), or "P-BTQR" (unpenalized). Default is "PDAL-BTQR".
n_iter	Total number of MCMC iterations. Default is 5000.

burn_in	Number of burn-in iterations to discard. Default is 1000.
thin	Thinning interval for MCMC chain. Default is 1.
hyperparams	List of hyperparameter prior settings: e_0 , f_0 , g_0 , h_0 , c_0 , d_0 .
verbose	Logical indicating whether to print MCMC progress. Default is FALSE.

Details

The function constructs a double-penalty Bayesian Tobit quantile regression model to perform parameter estimation and variable selection for longitudinal or clustered data restricted by bilateral interval limits. Latent variables are sampled from truncated normal distributions, mixture parameters from Inverse Gaussian distributions, and penalty parameters from Gamma distributions.

Value

An object of class BDPTobitQR containing:

coefficients	Posterior mean estimates of fixed effects.
sd	Posterior standard errors of fixed effects.
cred_int	95% equal-tailed posterior credible intervals for fixed effects.
hdi	95% highest density intervals for fixed effects.
random_effects	Posterior mean estimates of subject-specific random effects.
sigma	Posterior estimate of scale parameter sigma.
fitted.values	Fitted values for response variable.
residuals	Residuals (observed response minus fitted values).
dic	Deviance Information Criterion (DIC).
lpml	Log Pseudo-Marginal Likelihood (LPML).
mse	Mean Squared Error of fitted model.
mae	Mean Absolute Error of fitted model.
mcmc	List of MCMC chains for fixed effects, random effects, sigma, and penalties.
call	Matched call.
tau	Quantile level.
method	Method name.

References

Zhao, K., Shu, T., Hu, C., and Luo, Y. (2024). Research on Quantile Regression Method for Longitudinal Interval-Censored Data Based on Bayesian Double Penalty. *Mathematics*, 12(12), 1782. [doi:10.3390/math12121782](https://doi.org/10.3390/math12121782)

Examples

```
# Simulate longitudinal data
dat <- sim_longitudinal_data(n = 10, m = 4, p = 3, tau = 0.5, seed = 123)

# Fit PDAL-BTQR model
fit <- bdp_tobit_qr(
  formula = y ~ x1 + x2 + x3,
  random = ~ 1,
  data = dat,
  id = dat$id,
  lower = dat$lower,
  upper = dat$upper,
  tau = 0.5,
  method = "PDAL-BTQR",
  n_iter = 500,
  burn_in = 100
)

summary(fit)
print(fit)
plot(fit)
```

crime_data	<i>Interprovincial Longitudinal Crime Rate Dataset</i>
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Description

A longitudinal dataset containing interprovincial crime rates and economic indicators across 31 provinces over 7 years (2010–2016), as analyzed in Section 4 of Zhao et al. (2024).

Usage

```
data(crime_data)
```

Format

- A data frame with 217 rows and 10 variables:
- id Province identifier (1–31).
 - year Observation year (2010–2016).
 - y Crime rate (number of criminal suspects per 10,000 population).
 - x1 Per capita GDP.
 - x2 Urbanization rate.
 - x3 Regional income gap.
 - x4 Educational level.
 - x5 Unemployment rate.
 - lower Lower limit for interval/tobit censoring.
 - upper Upper limit for interval/tobit censoring.

References

Zhao, K., Shu, T., Hu, C., and Luo, Y. (2024). Research on Quantile Regression Method for Longitudinal Interval-Censored Data Based on Bayesian Double Penalty. *Mathematics*, 12(12), 1782. [doi:10.3390/math12121782](https://doi.org/10.3390/math12121782)

Examples

```
data(crime_data)
head(crime_data)
```

sim_longitudinal_data	<i>Simulate Longitudinal Interval-Censored Data</i>
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Description

Generates synthetic longitudinal/panel datasets with interval, left, or right censoring under normal, Student-t, or Asymmetric Laplace random errors, as described in Zhao et al. (2024).

Usage

```
sim_longitudinal_data(
  n = 20,
  m = 5,
  p = 4,
  beta = NULL,
  lower_limit = -2,
  upper_limit = 4,
  err_dist = c("normal", "t", "ald"),
  tau = 0.5,
  seed = NULL
)
```

Arguments

n	Number of subjects/clusters. Default is 20.
m	Number of time points per subject. Default is 5.
p	Number of fixed-effects covariates. Default is 4.
beta	Vector of true fixed-effects coefficients. If NULL, generated automatically.
lower_limit	Lower censoring bound e_N. Default is -2.
upper_limit	Upper censoring bound e_M. Default is 4.
err_dist	Error distribution: "normal", "t", or "ald". Default is "normal".
tau	Quantile level for ALD errors. Default is 0.5.
seed	Optional random seed.

Value

A data frame containing simulated longitudinal data with columns `id`, `time`, `y`, `y_star`, `lower`, `upper`, and covariates `x1`, `x2`, etc.

References

Zhao, K., Shu, T., Hu, C., and Luo, Y. (2024). Research on Quantile Regression Method for Longitudinal Interval-Censored Data Based on Bayesian Double Penalty. *Mathematics*, 12(12), 1782. [doi:10.3390/math12121782](https://doi.org/10.3390/math12121782)

Examples

```
dat <- sim_longitudinal_data(n = 10, m = 4, p = 3, seed = 42)
head(dat)
```

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