

Package ‘pqrfe’

July 23, 2025

Type Package

Title Penalized Quantile Regression with Fixed Effects

Version 1.1

Date 2022-12-01

Description

Quantile regression with fixed effects is a general model for longitudinal data. Here we proposed to solve it by several methods. The estimation methods include three loss functions as check, asymmetric least square and asymmetric Huber functions; and three structures as simple regression, fixed effects and fixed effects with penalized intercepts by LASSO.

License GPL (≥ 2)

Imports Rcpp ($\geq 1.0.5$), MASS ($\geq 7.3-49$)

LinkingTo Rcpp, RcppArmadillo

Suggests tinytest ($\geq 1.3.1$)

RoxygenNote 7.2.1

NeedsCompilation yes

Author Ian Meneghel Danilevich [aut, cre] (ORCID:
<<https://orcid.org/0000-0003-4541-0524>>),
Valderio A Reisen [aut],
Pascal Bondon [aut]

Maintainer Ian Meneghel Danilevich <iandanilevich@gmail.com>

Repository CRAN

Date/Publication 2022-12-01 11:20:02 UTC

Contents

pqrfe-package	2
check_lambda	4
choice_p	4
clean_data	5
d_psi_als	6
d_psi_mq	6

f_den	7
f_tab	7
loss_er	8
loss_erfe	8
loss_erlasso	9
loss_mqr	10
loss_mqrfe	10
loss_mqrlasso	11
loss_qr	12
loss_qrfe	12
loss_qrlasso	13
mpqr	13
optim_er	14
optim_erfe	15
optim_erlasso	16
optim_mqr	16
optim_mqrfe	17
optim_mqrlasso	18
optim_qr	18
optim_qrfe	19
optim_qrlasso	20
plot_taus	20
pqr	22
print.PQR	23
psi_als	23
psi_mq	24
q_cov	24
rho_koenker	25
rho_mq	26
sgf	26

Index	27
--------------	-----------

Description

Quantile regression with fixed effects is a general model for longitudinal data. Here we proposed to solve it by several methods. The estimation methods include three loss functions as check, asymmetric least square and asymmetric Huber functions; and three structures as simple regression, fixed effects and fixed effects with penalized intercepts by LASSO.

Package Content

Index of help topics:

check_lambda	check lambda
choice_p	choice model
clean_data	Clean missings
d_psi_als	D Psi ALS
d_psi_mq	D Psi M-quantile
f_den	Kernel density
f_tab	Tabular function
loss_er	Loss expectile regression
loss_erfe	Loss expectile regression with fixed effects
loss_erlasso	Loss lasso expectile regression with fixed effects
loss_mqr	Loss M-quantile regression
loss_mqrfe	Loss M-quantile regression with fixed effects
loss_mqrlasso	Loss lasso M-quantile regression with fixed effects
loss_qr	Loss quantile regression
loss_qrfe	Loss quantile regression with fixed effects
loss_qrlasso	Loss lasso quantile regression with fixed effects
mpqr	Multiple penalized quantile regression
optim_er	optim expectile regression
optim_erfe	optim expectile regression with fixed effects
optim_erlasso	optim expectile regression with fixed effects and LASSO
optim_mqr	optim M-quantile regression
optim_mqrfe	optim quantile regression with fixed effects
optim_mqrlasso	optim M-quantile regression with fixed effects and LASSO
optim_qr	optim quantile regression
optim_qrfe	optim quantile regression with fixed effects
optim_qrlasso	optim quantile regression with fixed effects and LASSO
plot_taus	Plot multiple penalized quantile regression
pqr	Penalized quantile regression with fixed effects
pqrfe-package	Penalized Quantile Regression with Fixed Effects
print.PQR	Print an PQR
psi_als	Psi ALS
psi_mq	Psi M-quantile
q_cov	Covariance
rho_koenker	Rho Koenker
rho_mq	Rho M-quantile
sgf	Identify significance

Maintainer

NA

Author(s)

NA

check_lambda	<i>check lambda</i>
--------------	---------------------

Description

check lambda

Usage

```
check_lambda(lambda, infb, supb)
```

Arguments

lambda	Numeric, value of lambda.
infb	Numeric, lower bound of lambda.
supb	Numeric, upper bound of lambda.

Value

lambda Numeric, valid value of lambda.

choice_p	<i>choice model</i>
----------	---------------------

Description

choice model

Usage

```
choice_p(effect)
```

Arguments

effect	Factor, simple, fixed or lasso.
--------	---------------------------------

Value

penalty Numeric, 1, 2 and 3.

clean_data	<i>Clean missings</i>
------------	-----------------------

Description

Clean missings

Usage

```
clean_data(y, x, id)
```

Arguments

y	Numeric vector, outcome.
x	Numeric matrix, covariates
id	Numeric vector, identifies the unit to which the observation belongs.

Value

list with the same objects y, x, id, but without missings.

Examples

```
n = 10
m = 4
d = 3
N = n*m
L = N*d
x = matrix(rnorm(L), ncol=d, nrow=N)
subj = rep(1:n, each=m)
alpha = rnorm(n)
beta = rnorm(d)
eps = rnorm(N)
y = x %*% beta + matrix(rep(alpha, each=m) + eps)
y = as.vector(y)
x[1,3] = NA
clean_data(y=y, x=x, id=subj)
```

d_psi_als	<i>D Psi ALS</i>
-----------	------------------

Description

Derivative of Psi asymmetric least square

Usage

d_psi_als(x, tau)

Arguments

x generic vector
tau percentile

Value

y vector, linear transformation by derivative ALS psi

d_psi_mq	<i>D Psi M-quantile</i>
----------	-------------------------

Description

Derivative of psi M-quantile

Usage

d_psi_mq(x, tau, c)

Arguments

x generic vector
tau percentile
c tuning

Value

y vector, linear transformation by second derivative m-rho

f_den	<i>Kernel density</i>
-------	-----------------------

Description

Kernel density

Usage

f_den(x)

Arguments

x Numeric vector.

Value

y vector, kernel density estimation.

Examples

```
x = rnorm(10)
f_den(x)
```

f_tab	<i>Tabular function</i>
-------	-------------------------

Description

Tabular function

Usage

f_tab(N, n, d, theta, sig2, kind)

Arguments

N sample size.
n length of alpha.
d length of beta.
theta Numeric vector.
sig2 Numeric vector.
kind Numeric, 1 means alpha, 2 means beta

Value

a list with a dataframe Core and a matrix Matx, both display the same information

loss_er	<i>Loss expectile regression</i>
---------	----------------------------------

Description

This function returns the core of expectile regression to be minimized

Usage

```
loss_er(beta, x, y, tau, N, d)
```

Arguments

beta	initial values
x	design matrix
y	vector output
tau	percentile
N	sample size
d	columns of x

Value

eta Numeric, sum of expectile regression

loss_erfe	<i>Loss expectile regression with fixed effects</i>
-----------	---

Description

This function returns the core of expectile regression with fixed effects to be minimized

Usage

```
loss_erfe(theta, x, y, z, tau, n, d, mm)
```


Arguments

theta	initial values
x	design matrix
y	vector output
z	incident matrix
tau	percentile
n	N sample size
d	columns of x
mm	n columns of z

Value

eta Numeric, sum of expectile regression with fixed effects

loss_erlasso	<i>Loss lasso expectile regression with fixed effects</i>
--------------	---

Description

This function returns the core of lasso expectile regression with fixed effects to be minimized

Usage

```
loss_erlasso(theta, x, y, z, tau, n, d, mm, lambda)
```

Arguments

theta	initial values
x	design matrix
y	vector output
z	incident matrix
tau	percentile
n	N sample size
d	columns of x
mm	n columns of z
lambda	constriction parameter

Value

eta Numeric, sum of lasso expectile regression with fixed effects

loss_mqr	<i>Loss M-quantile regression</i>
----------	-----------------------------------

Description

This function returns the core of M-quantile regression to be minimized

Usage

```
loss_mqr(beta, x, y, tau, N, d, c)
```

Arguments

beta	initial values
x	design matrix
y	vector output
tau	percentile
N	sample size
d	columns of x
c	tuning

Value

eta Numeric, sum of M-quantile regression

loss_mqrfe	<i>Loss M-quantile regression with fixed effects</i>
------------	--

Description

This function returns the core of M-quantile regression with fixed effects to be minimized

Usage

```
loss_mqrfe(theta, x, y, z, tau, n, d, mm, c)
```

Arguments

theta	initial values
x	design matrix
y	vector output
z	incident matrix
tau	percentile
n	N sample size
d	columns of x
mm	n columns of z
c	tuning

Value

eta Numeric, sum of M-quantile regression with fixed effects

loss_mqrlasso	<i>Loss lasso M-quantile regression with fixed effects</i>
---------------	--

Description

This function returns the core of lasso M-quantile regression with fixed effects to be minimized

Usage

```
loss_mqrlasso(theta, x, y, z, tau, n, d, mm, c, lambda)
```

Arguments

theta	initial values
x	design matrix
y	vector output
z	incident matrix
tau	percentile
n	N sample size
d	columns of x
mm	n columns of z
c	tuning
lambda	constriction parameter

Value

eta Numeric, sum of lasso M-quantile regression with fixed effects

loss_qr	<i>Loss quantile regression</i>
---------	---------------------------------

Description

This function returns the core of quantile regression to be minimized

Usage

```
loss_qr(beta, x, y, tau, N, d)
```

Arguments

beta	initial values
x	design matrix
y	vector output
tau	percentile
N	sample size
d	columns of x

Value

eta Numeric, sum of quantile regression

loss_qrfe	<i>Loss quantile regression with fixed effects</i>
-----------	--

Description

This function returns the core of quantile regression with fixed effects to be minimized

Usage

```
loss_qrfe(theta, x, y, z, tau, n, d, mm)
```

Arguments

theta	initial values
x	design matrix
y	vector output
z	incident matrix
tau	percentile
n	N sample size
d	columns of x
mm	n columns of z

Value

eta Numeric, sum of quantile regression with fixed effects

loss_qrlasso	<i>Loss lasso quantile regression with fixed effects</i>
--------------	--

Description

This function returns the core of lasso quantile regression with fixed effects to be minimized

Usage

```
loss_qrlasso(theta, x, y, z, tau, n, d, mm, lambda)
```

Arguments

theta	initial values
x	design matrix
y	vector output
z	incident matrix
tau	percentile
n	N sample size
d	columns of x
mm	n columns of z
lambda	constriction parameter

Value

eta Numeric, sum of lasso quantile regression with fixed effects

mpqr	<i>Multiple penalized quantile regression</i>
------	---

Description

Estimate penalized quantile regression for several taus

Usage

```
mpqr(x, y, subj, tau = 1:9/10, effect = "simple", c = 0)
```

Arguments

x	Numeric matrix, covariates
y	Numeric vector, outcome.
subj	Numeric vector, identifies the unit to which the observation belongs.
tau	Numeric vector, identifies the percentiles.
effect	Factor, "simple" simple regression, "fixed" regression with fixed effects, "lasso" penalized regression with fixed effects.
c	Numeric, 0 is quantile, Inf is expectile, any number between zero and infinite is M-quantile.

Value

Beta Numeric array, with three dimensions: 1) tau, 2) coef., lower bound, upper bound, 3) exploratory variables.

Beta array with dimension (ntau, 3, d), where Beta[i,1,k] is the i-th tau estimation of beta_k, Beta[i,2,k] is the i-th tau lower bound 95% confidence of beta_k, and Beta[i,3,k] is the i-th tau lower bound 95% confidence of beta_k.

Examples

```
n = 10
m = 5
d = 4
N = n*m
L = N*d
x = matrix(rnorm(L), ncol=d, nrow=N)
subj = rep(1:n, each=m)
alpha = rnorm(n)
beta = rnorm(d)
eps = rnorm(N)
y = as.vector(x %*% beta + rep(alpha, each=m) + eps)

Beta = mpqr(x,y,subj,tau=1:9/10, effect="fixed", c = 1.2)
Beta
```

optim_er

optim expectile regression

Description

This function solves a expectile regression

Usage

```
optim_er(beta, x, y, tau, N, d)
```

Arguments

beta	Numeric vector, initials values beta.
x	Numeric matrix, covariates.
y	Numeric vector, output.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.

Value

parametric vector and residuals.

optim_erfe	<i>optim expectile regression with fixed effects</i>
------------	--

Description

This function solves a expectile regression with fixed effects

Usage

```
optim_erfe(beta, alpha, x, y, z, tau, N, d, n)
```

Arguments

beta	Numeric vector, initials values beta.
alpha	Numeric vector, initials values alpha.
x	Numeric matrix, covariates.
y	Numeric vector, output.
z	Numeric matrix, incidence matrix.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.
n	Numeric integer, length of alpha.

Value

parametric vector and residuals.

optim_erlasso	<i>optim expectile regression with fixed effects and LASSO</i>
---------------	--

Description

This function solves a expectile regression with fixed effects and LASSO

Usage

```
optim_erlasso(beta, alpha, x, y, z, tau, N, d, n)
```

Arguments

beta	Numeric vector, initials values beta.
alpha	Numeric vector, initials values alpha.
x	Numeric matrix, covariates.
y	Numeric vector, output.
z	Numeric matrix, incidence matrix.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.
n	Numeric integer, length of alpha.

Value

parametric vector and residuals.

optim_mqr	<i>optim M-quantile regression</i>
-----------	------------------------------------

Description

This function solves a M-quantile regression

Usage

```
optim_mqr(beta, x, y, tau, N, d, c)
```


Arguments

beta	Numeric vector, initials values beta.
x	Numeric matrix, covariates.
y	Numeric vector, output.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.
c	Numeric, positive real value.

Value

parametric vector and residuals.

optim_mqrfe	<i>optim quantile regression with fixed effects</i>
-------------	---

Description

This function solves a quantile regression with fixed effects

Usage

```
optim_mqrfe(beta, alpha, x, y, z, tau, N, d, n, c)
```

Arguments

beta	Numeric vector, initials values beta.
alpha	Numeric vector, initials values alpha.
x	Numeric matrix, covariates.
y	Numeric vector, output.
z	Numeric matrix, incidence matrix.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.
n	Numeric integer, length of alpha.
c	Numeric, positive real value.

Value

parametric vector and residuals.

optim_mqrlasso	<i>optim M-quantile regression with fixed effects and LASSO</i>
----------------	---

Description

This function solves a M-quantile regression with fixed effects and LASSO

Usage

```
optim_mqrlasso(beta, alpha, x, y, z, tau, N, d, n, c)
```

Arguments

beta	Numeric vector, initials values beta.
alpha	Numeric vector, initials values alpha.
x	Numeric matrix, covariates.
y	Numeric vector, output.
z	Numeric matrix, incidence matrix.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.
n	Numeric integer, length of alpha.
c	Numeric, positive real value.

Value

parametric vector and residuals.

optim_qr	<i>optim quantile regression</i>
----------	----------------------------------

Description

This function solves a quantile regression

Usage

```
optim_qr(beta, x, y, tau, N, d)
```

Arguments

beta	Numeric vector, initials values.
x	Numeric matrix, covariates.
y	Numeric vector, output.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.

Value

parametric vector and residuals.

optim_qrfe	<i>optim quantile regression with fixed effects</i>
------------	---

Description

This function solves a quantile regression with fixed effects

Usage

```
optim_qrfe(beta, alpha, x, y, z, tau, N, d, n)
```

Arguments

beta	Numeric vector, initials values beta.
alpha	Numeric vector, initials values alpha.
x	Numeric matrix, covariates.
y	Numeric vector, output.
z	Numeric matrix, incidence matrix.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.
n	Numeric integer, length of alpha.

Value

parametric vector and residuals.

optim_qrlasso	<i>optim quantile regression with fixed effects and LASSO</i>
---------------	---

Description

This function solves a quantile regression with fixed effects and LASSO

Usage

```
optim_qrlasso(beta, alpha, x, y, z, tau, N, d, n)
```

Arguments

beta	Numeric vector, initials values beta.
alpha	Numeric vector, initials values alpha.
x	Numeric matrix, covariates.
y	Numeric vector, output.
z	Numeric matrix, incidence matrix.
tau	Numeric scalar, the percentile.
N	Numeric integer, sample size.
d	Numeric integer, X number of columns.
n	Numeric integer, length of alpha.

Value

parametric vector and residuals.

plot_taus	<i>Plot multiple penalized quantile regression</i>
-----------	--

Description

plot penalized quantile regression for several taus

Usage

```
plot_taus(
  Beta,
  tau = 1:9/10,
  D,
  col = 2,
  lwd = 1,
  lty = 2,
```

```

    pch = 16,
    cex.axis = 1,
    cex.lab = 1,
    main = "",
    shadow = "gray90"
)

```

Arguments

Beta	Numeric array, with three dimensions: 1) tau, 2) coef., lower bound, upper bound, 3) exploratory variables.
tau	Numeric vector, identifies the percentiles.
D	covariate's number.
col	color.
lwd	line width.
lty	line type.
pch	point character.
cex.axis	cex axis length.
cex.lab	cex axis length.
main	title.
shadow	color of the Confidence Interval 95%

Value

None

Examples

```

n = 10
m = 5
d = 4
N = n*m
L = N*d
x = matrix(rnorm(L), ncol=d, nrow=N)
subj = rep(1:n, each=m)
alpha = rnorm(n)
beta = rnorm(d)
eps = rnorm(N)
y = as.vector(x %*% beta + rep(alpha, each=m) + eps)

Beta = mpqr(x,y,subj,tau=1:9/10, effect="lasso", c = Inf)
plot_taus(Beta,tau=1:9/10,D=1)

```

pqr

*Penalized quantile regression with fixed effects***Description**

Estimate parameters and tuning parameter.

Usage

```
pqr(x, y, subj, tau = 0.5, effect = "simple", c = 1)
```

Arguments

x	Numeric matrix, covariates
y	Numeric vector, outcome.
subj	Numeric vector, identifies the unit to which the observation belongs.
tau	Numeric scalar between zero and one, identifies the percentile.
effect	Factor, "simple" simple regression, "fixed" regression with fixed effects, "lasso" penalized regression with fixed effects.
c	Numeric, 0 is quantile, Inf is expectile, any number between zero and infinite is M-quantile.

Value

alpha Numeric vector, intercepts' coefficients.
 beta Numeric vector, exploratory variables' coefficients.
 lambda Numeric, estimated lambda.
 res Numeric vector, percentile residuals.
 tau Numeric scalar, the percentile.
 penalty Numeric scalar, indicate the chosen effect.
 c Numeric scalar, indicate the chosen c.
 sig2_alpha Numeric vector, intercepts' standard errors.
 sig2_beta Numeric vector, exploratory variables' standard errors.
 Tab_alpha Data.frame, intercepts' summary.
 Tab_beta Data.frame, exploratory variables' summary.
 Mat_alpha Numeric matrix, intercepts' summary.
 Mat_beta Numeric matrix, exploratory variables' summary.

References

Koenker, R. (2004) "Quantile regression for longitudinal data", J. Multivar. Anal., 91(1): 74-89, <doi:10.1016/j.jmva.2004.05.006>

Examples

```

n = 10
m = 5
d = 4
N = n*m
x = matrix(rnorm(d*N), ncol=d, nrow=N)
subj = rep(1:n, each=m)
alpha = rnorm(n)
beta = rnorm(d)
eps = rnorm(N)
y = as.vector(x %*% beta + rep(alpha, each=m) + eps)
m1 = pqr(x=x, y=y, subj=subj, tau=0.75, effect="lasso", c = 0)
m1$Tab_beta

```

print.PQR

Print an PQR

Description

Define the visible part of the object class PQR

Usage

```

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

```

Arguments

x	An object of class "PQR"
...	further arguments passed to or from other methods.

Value

None

psi_als

Psi ALS

Description

Psi asymmetric least square

Usage

```
psi_als(x, tau)
```

Arguments

x generic vector
tau percentile

Value

y vector, linear transformation by ALS psi

psi_mq	<i>Psi M-quantile</i>
--------	-----------------------

Description

Psi M-quantile

Usage

psi_mq(x, tau, c)

Arguments

x generic vector
tau percentile
c tuning

Value

y vector, linear transformation by m-rho derivative

q_cov	<i>Covariance</i>
-------	-------------------

Description

Estimate Covariance matrix

Usage

q_cov(n, N, d, Z, X, tau, res, penalty, c)

Arguments

n	length of alpha.
N	sample size.
d	length of beta.
Z	Numeric matrix, incident matrix.
X	Numeric matrix, covariates.
tau	Numeric, identifies the percentile.
res	Numeric vector, residuals.
penalty	Numeric, 1 quantile regression, 2 quantile regression with fixed effects, 3 Lasso quantile regression with fixed effects
c	Numeric, tuning

Value

a list with two matrices: sig2_alpha (which is the matrix of covariance of estimated alpha) and sig2_beta (which is the matrix of covariance of estimated beta)

rho_koenker	<i>Rho Koenker</i>
-------------	--------------------

Description

Rho Koenker

Usage

rho_koenker(x, tau)

Arguments

x	generic vector
tau	percentile

Value

y vector, linear transformation by rho

rho_mq	<i>Rho M-quantile</i>
--------	-----------------------

Description

Rho M-quantile

Usage

```
rho_mq(x, tau, c)
```

Arguments

x	generic vector
tau	percentile
c	tuning

Value

y vector, linear transformation by m-rho

sgf	<i>Identify significance</i>
-----	------------------------------

Description

Identify significance

Usage

```
sgf(x)
```

Arguments

x	Numeric vector.
---	-----------------

Value

y vector Factor, symbol flag of significant p-values.
a vector of Factors, i.e., the symbols to help p-value interpretation

Examples

```
n = 10
pvalue = rgamma(10,1,10)
sgf(pvalue)
```

Index

- * **package**
 - pqrfe-package, [2](#)
- check_lambda, [4](#)
- choice_p, [4](#)
- clean_data, [5](#)
- d_psi_als, [6](#)
- d_psi_mq, [6](#)
- f_den, [7](#)
- f_tab, [7](#)
- loss_er, [8](#)
- loss_erfe, [8](#)
- loss_erlasso, [9](#)
- loss_mqr, [10](#)
- loss_mqrfe, [10](#)
- loss_mqrlasso, [11](#)
- loss_qr, [12](#)
- loss_qrfe, [12](#)
- loss_qrlasso, [13](#)
- mpqr, [13](#)
- optim_er, [14](#)
- optim_erfe, [15](#)
- optim_erlasso, [16](#)
- optim_mqr, [16](#)
- optim_mqrfe, [17](#)
- optim_mqrlasso, [18](#)
- optim_qr, [18](#)
- optim_qrfe, [19](#)
- optim_qrlasso, [20](#)
- plot_taus, [20](#)
- pqr, [22](#)
- pqrfe (pqrfe-package), [2](#)
- pqrfe-package, [2](#)
- print.PQR, [23](#)
- psi_als, [23](#)
- psi_mq, [24](#)
- q_cov, [24](#)
- rho_koenker, [25](#)
- rho_mq, [26](#)
- sgf, [26](#)