

# Package: alqrfe (via r-universe)

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**Title** Adaptive Lasso Quantile Regression with Fixed Effects

**Version** 1.3

**Description** Quantile regression with fixed effects solves longitudinal data, considering the individual intercepts as fixed effects. The parametric set of this type of problem used to be huge. Thus penalized methods such as Lasso are currently applied. Adaptive Lasso presents oracle proprieties, which include Gaussianity and correct model selection. Bayesian information criteria (BIC) estimates the optimal tuning parameter lambda. Plot tools are also available.

**License** GPL (>= 2)

**Depends** R (>= 4.4.0)

**Imports** Rcpp (>= 1.0.5), MASS (>= 7.3-49), stats

**LinkingTo** Rcpp, RcppArmadillo

**Encoding** UTF-8

**RoxygenNote** 7.3.3

**NeedsCompilation** yes

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**Suggests** testthat (>= 3.0.0)

**Config/testthat/edition** 3

**Repository** <https://iandanilevicz.r-universe.dev>

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

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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)
```

---

|     |                                               |
|-----|-----------------------------------------------|
| mqr | <i>multiple penalized quantile regression</i> |
|-----|-----------------------------------------------|

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## Description

Estimate QR for several taus

## Usage

```
mqr(x, y, subj, tau = 1:9/10, method = "qr", ngrid = 20, inf = 1e-08, digt = 4)
```

## 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.                                                                                                                                                          |
| method | Factor, "qr" quantile regression, "qrfe" quantile regression with fixed effects, "lqrfe" Lasso quantile regression with fixed effects, "alqr" adaptive Lasso quantile regression with fixed effects. |
| ngrid  | Numeric scalar greater than one, number of BIC to test.                                                                                                                                              |
| inf    | Numeric scalar, internal value, small value.                                                                                                                                                         |
| digt   | Numeric scalar, internal value greater than one, define "zero" coefficient.                                                                                                                          |

## Value

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

## 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 = x %*% beta + matrix(rep(alpha, each=m) + eps)
y = as.vector(y)

Beta = mqr(x,y,subj,tau=1:9/10, method="qr", ngrid = 10)
Beta
```

---

|           |                                                       |
|-----------|-------------------------------------------------------|
| mqr_alpha | <i>multiple penalized quantile regression - alpha</i> |
|-----------|-------------------------------------------------------|

---

### Description

Estimate QR intercepts for several taus

### Usage

```
mqr_alpha(
  x,
  y,
  subj,
  tau = 1:9/10,
  method = "qr",
  ngrid = 20,
  inf = 1e-08,
  digt = 4
)
```

### 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.                                                                                                                                                          |
| method | Factor, "qr" quantile regression, "qrfe" quantile regression with fixed effects, "lqrfe" Lasso quantile regression with fixed effects, "alqr" adaptive Lasso quantile regression with fixed effects. |
| ngrid  | Numeric scalar greater than one, number of BIC to test.                                                                                                                                              |
| inf    | Numeric scalar, internal value, small value.                                                                                                                                                         |
| digt   | Numeric scalar, internal value greater than one, define "zero" coefficient.                                                                                                                          |

### Value

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

### 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 = x %% beta + matrix(rep(alpha, each=m) + eps)
y = as.vector(y)

Alpha = mqr(x,y,subj,tau=1:9/10, method="qr", ngrid = 10)
Alpha

```

plot\_alpha

*plot multiple penalized quantile regression - alpha***Description**

plot QR intercepts for several taus

**Usage**

```

plot_alpha(
  Beta,
  tau = 1:9/10,
  D,
  ylab = expression(alpha[1]),
  col = 2,
  lwd = 1,
  lty = 2,
  pch = 1,
  cex.axis = 1,
  cex.lab = 1,
  main = ""
)

```

**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        | intercept's number.                                                                                         |
| ylab     | y legend                                                                                                    |
| col      | color.                                                                                                      |
| lwd      | line width.                                                                                                 |
| lty      | line type.                                                                                                  |
| pch      | point character.                                                                                            |
| cex.axis | cex axis length.                                                                                            |
| cex.lab  | cex axis length.                                                                                            |
| main     | title.                                                                                                      |

**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 = x %*% beta + matrix(rep(alpha, each=m) + eps)
y = as.vector(y)

Beta = mqr_alpha(x,y,subj,tau=1:9/10, method="qr", ngrid = 10)
plot_alpha(Beta,tau=1:9/10,D=1)

```

plot\_taus

*plot multiple penalized quantile regression***Description**

plot QR for several taus

**Usage**

```

plot_taus(
  Beta,
  tau = 1:9/10,
  D,
  col = 2,
  lwd = 1,
  lty = 2,
  pch = 1,
  cex.axis = 1,
  cex.lab = 1,
  main = ""
)

```

**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.           |

### 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 = x %*% beta + matrix(rep(alpha, each=m) + eps)
y = as.vector(y)

Beta = mqr(x,y,subj,tau=1:9/10, method="qr", ngrid = 10)
plot_taus(Beta,tau=1:9/10,D=1)

```

qr

*quantile regression*

### Description

Estimate quantile regression parameters for any quantile.

#### Remarks:

1. If the first column of 'x' is entirely equal to 1, then the first element of 'beta' represents the common intercept. Otherwise, there is no default common intercept (unlike the default behavior in 'lm').
2. If there is a common intercept and 'method' is "qrfe", "lqrfe" or "alqrfe", a 'sum-to-zero constraint' is applied on the 'alpha' parameters:

$$\sum_{i=1}^n \alpha_i = 0$$

This follows the approach in Danilevicz (2025).

### Usage

```
qr(x, y, subj, tau = 0.5, method = "qrfe", ngrid = 20, inf = 1e-08, digit = 4)
```

## Arguments

|        |                                                                                                                                                                                                        |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| x      | Numeric matrix, covariates                                                                                                                                                                             |
| y      | Numeric vector, outcome.                                                                                                                                                                               |
| subj   | Numeric vector, identifies the unit to which the observation belongs.                                                                                                                                  |
| tau    | Numeric, identifies the percentile.                                                                                                                                                                    |
| method | Factor, "qr" quantile regression, "qrfe" quantile regression with fixed effects, "lqrfe" Lasso quantile regression with fixed effects, "alqrfe" adaptive Lasso quantile regression with fixed effects. |
| ngrid  | Numeric scalar greater than one, number of BIC to test.                                                                                                                                                |
| inf    | Numeric scalar, internal value, small value.                                                                                                                                                           |
| digit  | Numeric scalar, internal value greater than one, define "zero" coefficient.                                                                                                                            |

## 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.

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.

method Factor, method applied.

## References

Danilevicz, I.M., Bondon, P., Reisen, V.A. (2025) "Adaptive LASSO Quantile Regression with Fixed Effects", Appl. Math. Model., xx (xx), <doi:10.1016/j.apm.2025.116600>

Danilevicz, I.M., Reisen, V.A., Bondon, P. (2024) "Expectile and M-quantile regression for panel data", Stat. Comput., 34 (97), <doi:10.1007/s11222-024-10396-7>

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

**Examples**

```
# Example 1
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 = x %*% beta + matrix(rep(alpha, each=m) + eps)
y = as.vector(y)
m1 = qr(x,y,subj,tau=0.75, method="qrfe")
m1
m2 = qr(x,y,subj,tau=0.3, method="lqrfe", ngrid = 10)
m2

# Example 2, from MASS package
Rabbit = MASS::Rabbit
Rabbit$Treatment = ifelse(Rabbit$Treatment=="Control",0,1)
Rabbit$Animal = ifelse(Rabbit$Animal == "R1",1,ifelse(Rabbit$Animal == "R2",2,
ifelse(Rabbit$Animal == "R3",3,ifelse(Rabbit$Animal == "R4",4,5))))
X = matrix(cbind(Rabbit$Dose,Rabbit$Treatment), ncol=2)
m3 = qr(x=X, y=Rabbit$BPchange, subj=Rabbit$Animal,tau=0.5, method="alqrfe", ngrid = 10)
m3
```

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