

Package: mixqrgate (via r-universe)

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Type Package

Title Location-Varying Gating for Mixtures of Quantile Regressions

Version 0.1.2

Description Extends finite mixtures of quantile regressions (the 'mixqr' package) with a concomitant-covariate, quantile-indexed mixing gate. The mixing probabilities follow a multinomial-logit model whose coefficients may depend on a separate set of gating covariates and on the quantile level, so that latent-class membership can change across the conditional distribution. This turns the location-varying mixing idea of Furno (2025) into a likelihood and EM object with proper standard errors on the gate. Estimation reuses the 'mixqr' component and error-density machinery; the gate is fit by a weighted multinomial-logistic M-step and reduces exactly to a constant gate when the gating model is an intercept only.

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Depends R (>= 4.1)

Imports mixqr (>= 0.1.1), stats, graphics

Suggests nnet, ggplot2, testthat (>= 3.0.0), knitr, rmarkdown

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confint.mixqrgate	<i>Confidence intervals for the gate coefficients</i>
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Description

Confidence intervals for the gate coefficients

Usage

```
## S3 method for class 'mixqrgate'  
confint(object, parm, level = 0.95, tau = NULL, ...)
```

Arguments

object	A "mixqrgate" object.
parm	Ignored; intervals are returned for all gate coefficients.
level	Confidence level.
tau	Quantile level at which to report the (location-varying) gate; defaults to the first grid point.
...	Unused.

Value

A matrix of lower/upper limits for the gate coefficients.

mixqrgate

*Fit a gated mixture of quantile regressions***Description**

Fits a finite mixture of tau-quantile regressions whose mixing probabilities follow a multinomial-logit gate on concomitant covariates, optionally indexed by the quantile level. The gate turns the location-varying mixing of Furno (2025) into a likelihood/EM object with standard errors.

Usage

```

mixqrgate(
  formula,
  data,
  gating = ~1,
  G = 2L,
  tau = 0.5,
  vary_gating = c("none", "discrete"),
  method = c("ald", "kde"),
  variance = c("sandwich", "louis", "stochEM"),
  gate_B = 200L,
  control = mixqrgate_control()
)

```

Arguments

formula	Component model, $y \sim x_1 + x_2$ (intercept implied).
data	A data frame.
gating	One-sided concomitant gate formula in the gating covariates; <code>~1</code> (default) reproduces a constant gate (and the plain <code>mixqr</code> fit).
G	Number of components. Default 2.
tau	Quantile level(s) in (0, 1). A vector triggers a location-varying (per-tau) gate.
vary_gating	"none" (gate depends on covariates, not tau) or "discrete" (a separate gate per tau-grid point; Furno mode).
method	"ald" (parametric asymmetric-Laplace, genuine likelihood) or "kde" (Wu & Yao nonparametric error densities).
variance	Gate standard errors. "sandwich" (default) is the observed-information sandwich <i>conditional on the fitted class memberships</i> , so it under-covers when components overlap. "louis" applies Louis's (1982) identity to the gate block – an analytic, classification-aware covariance (complete information minus the missing information from the latent labels), the recommended choice for inference. "stochEM" is a multiple-imputation alternative (slower; a useful cross-check).
gate_B	Number of imputations for variance = "stochEM". Default 200.
control	A <code>mixqrgate_control()</code> list.

Value

An object of class "mixqrgate".

References

Furno, M. (2025). Finite Mixture at Quantiles and Expectiles. *JRFM* 18(4), 177.

Examples

```
set.seed(1)
d <- sim_gate2(n = 300)
fit <- mixqrgate(y ~ x, data = d, gating = ~ z, G = 2, tau = 0.5)
fit
```

mixqrgate_control	Control parameters for <code>mixqrgate()</code>
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Description

Control parameters for `mixqrgate()`

Usage

```
mixqrgate_control(
  nstart = 10L,
  maxit = 500L,
  tol = 1e-06,
  gate_ridge = 0.001,
  gate_maxit = 50L,
  gate_tol = 1e-08,
  label_order = "slope",
  bandwidth = NULL,
  kde_grid = 512L,
  trace = FALSE,
  seed = NULL
)
```

Arguments

nstart	Number of multi-start initialisations (the mixture likelihood is multimodal). Default 10.
maxit	Maximum EM iterations. Default 500.
tol	Convergence tolerance on the relative parameter change. Default 1e-6.
gate_ridge	Ridge penalty on the gate coefficients (stabilises the multinomial-logit M-step under separation / small samples). Default 1e-3.

gate_maxit, gate_tol	Inner Newton iterations / tolerance for the gate M-step. Defaults 50 and 1e-8.
label_order	Component ordering for label switching: "slope" (default, ascending first slope) or "intercept".
bandwidth	Optional KDE bandwidth override (method = "kde").
kde_grid	KDE grid size (method = "kde"). Default 512.
trace	Logical; print EM progress. Default FALSE.
seed	Optional integer RNG seed.

Value

A list of class "mixqrgate_control".

plot.mixqrgate	<i>Plot a gated mixture fit</i>
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Description

which = "gating" draws the class-average gate probability against the quantile level – the location-varying mixing picture that is Furno's headline finding. which = "fit" draws the data coloured by class with the component quantile lines at the first grid point.

Usage

```
## S3 method for class 'mixqrgate'
plot(x, which = c("gating", "fit"), ...)
```

Arguments

x	A "mixqrgate" object.
which	"gating" (default) or "fit".
...	Passed to graphics::plot() .

Value

Invisibly x.

predict.mixqrgate	<i>Predict gate probabilities or class membership</i>
-------------------	---

Description

Predict gate probabilities or class membership

Usage

```
## S3 method for class 'mixqrgate'
predict(object, newdata = NULL, type = c("prob", "class"), tau = NULL, ...)
```

Arguments

object	A "mixqrgate" object.
newdata	Optional data frame (must contain the gating covariates).
type	"prob" (gate probabilities) or "class" (most likely class).
tau	Quantile level at which to evaluate the (location-varying) gate; defaults to the first grid point.
...	Unused.

Value

A matrix of gate probabilities (type = "prob") or an integer vector of class labels (type = "class").

sim_gate2	<i>Simulate a two-component mixture with a concomitant gate</i>
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Description

Membership depends on a gating covariate z through a logit $\Pr(\text{class } 2 \mid z) = \text{plogis}(\text{gamma}[1] + \text{gamma}[2] z)$; the two components are quantile regressions of y on x with distinct slopes. Errors are median-zero.

Usage

```
sim_gate2(
  n = 400L,
  gamma = c(0, 1.5),
  b1 = c(2, -3),
  b2 = c(-2, 3),
  sigma = c(1, 1.5),
  loc_vary = 0,
  het = FALSE
)
```

Arguments

n	Sample size.
gamma	Length-2 gate coefficients (intercept, slope on z).
b1, b2	Length-2 (intercept, slope) for components 1 and 2.
sigma	Length-2 error scales.
loc_vary	Strength of the location-varying gate (0 = membership independent of the quantile rank; larger = stronger upper-tail tilt toward class 2).
het	If TRUE, component-2 spread grows with x (heteroscedastic).

Details

With `loc_vary > 0` the gate becomes **genuinely location-varying** in the sense of Furno (2025): membership also depends on the latent quantile rank, so class 2 is over-represented in the upper tail and the class composition – hence the fitted gate – shifts across the quantile level. With `het = TRUE` the second component’s spread grows with x.

Value

A data frame with y, x, z, and the true class.

References

Furno, M. (2025). Finite Mixture at Quantiles and Expectiles. *JRFM* 18(4), 177.

summary.mixqrgate	<i>Summarize a gated mixture fit</i>
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Description

Reports, per quantile level, the component coefficients and the **gate coefficients with standard errors, z- and p-values** – the inference on how membership depends on the gating covariates (and, across the grid, on tau).

Usage

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

Arguments

object	A "mixqrgate" object.
...	Unused.

Value

An object of class "summary.mixqrgate".

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