Package: within (via r-universe)

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Title High-Performance Fixed Effects Solver

Version 0.1.0

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Description Fast iterative solvers (CG, GMRES) with Schwarz domain-decomposition preconditioners for absorbing high-dimensional fixed effects in panel data regressions. The computational core is written in Rust via the 'within' crate and accessed through 'extendr'.

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Contents

solve *Solve fixed-effects normal equations*

Description

Computes fixed-effect coefficients by solving the normal equations $D^T W D x = D^T W y$ where D is the dummy-variable design matrix implied by `categories` and W is the diagonal weight matrix.

Usage

```
solve(
  categories,
  y,
  weights = NULL,
  method = c("cg", "gmres"),
  tol = 1e-08,
  maxiter = 1000L,
  restart = 30L,
  preconditioner = c("additive", "multiplicative", "off")
)
```

Arguments

`categories`	Integer matrix of shape (`n_obs`, `n_factors`). Each column contains **1-based** factor level assignments. Values must be positive integers with no `NA`s.
`y`	Numeric vector of length `n_obs`. The response variable.
`weights`	Numeric vector of length `n_obs` or `NULL` (default). Observation weights. `NULL` means unit weights (unweighted).
`method`	Character, one of `"cg"` (default) or `"gmres"`. `"cg"` uses Conjugate Gradient (requires symmetric preconditioner). `"gmres"` uses GMRES (supports all preconditioners).
`tol`	Convergence tolerance on the relative residual norm. Default `1e-8`.
`maxiter`	Maximum number of Krylov iterations. Default `1000L`.
`restart`	GMRES restart parameter (ignored for CG). Default `30L`.
`preconditioner`	Character, one of `"additive"` (default), `"multiplicative"`, or `"off"`. Schwarz preconditioner variant. `"multiplicative"` requires `method = "gmres"`.

Value

A named list with components:

coefficients Numeric vector of fixed-effect coefficient estimates.

demeaned Numeric vector. Response after subtracting estimated fixed effects.

converged Logical. Did the solver meet the tolerance?

iterations Integer. Number of Krylov iterations performed.

residual Numeric. Final relative residual norm.

time_total Numeric. Wall-clock seconds (setup + solve).

time_setup Numeric. Wall-clock seconds for operator/preconditioner construction.

time_solve Numeric. Wall-clock seconds for the iterative solve.

`solve_batch` *Solve fixed-effects normal equations for multiple response vectors*

Description

Builds the operator and preconditioner once, then solves for each column of `Y` in parallel. More efficient than calling `solve` in a loop.

Usage

```
solve_batch(
  categories,
  Y,
  weights = NULL,
  method = c("cg", "gmres"),
  tol = 1e-08,
  maxiter = 1000L,
  restart = 30L,
  preconditioner = c("additive", "multiplicative", "off")
)
```

Arguments

`categories`	Integer matrix of shape `(n_obs, n_factors)`. Each column contains **1-based** factor level assignments.
`Y`	Numeric matrix of shape `(n_obs, k)`. Each column is a separate response vector.
`weights`	Numeric vector of length `n_obs` or `NULL` (default).
`method`	Character, one of `"cg"` (default) or `"gmres"`.
`tol`	Convergence tolerance. Default `1e-8`.
`maxiter`	Maximum Krylov iterations. Default `1000L`.
`restart`	GMRES restart parameter. Default `30L`.
`preconditioner`	Character, one of `"additive"`, `"multiplicative"`, or `"off"`.

Value

A named list with components:

coefficients Numeric matrix `(n_dofs, k)`.

demeaned Numeric matrix `(n_obs, k)`.

converged Logical vector of length `k`.

iterations Integer vector of length `k`.

residual Numeric vector of length `k`.

time_total Numeric scalar. Wall-clock seconds for the entire batch.

time_solve Numeric vector of length `k`. Per-RHS solve time.

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