Package ‘MMeM’

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Title Multivariate Mixed Effects Model

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Description Analyzing data under multivariate mixed effects model using multivariate REML and multivariate Henderson3 methods.
See Meyer (1985) <doi:10.2307/2530651> and Wesolowska Janczarek (1984) <doi:10.1002/bimj.4710260613>.

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Imports stats, MASS, Matrix, jointDiag, lme4, matrixcalc, psych, stringr

BugReports https://github.com/pengluyaoyao/MMeM/issues

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R topics documented:

MMeM *MMeM: Estimating the variance covariance components of the multivariate mixed effects model*

Description

This package analyzes data under multivariate mixed effects model using multivariate REML and multivariate Henderson3 methods. Currently, it only supports multivariate mixed effects model with one fixed effects and one random effects and two response variates. See Meyer (1985) <doi:10.2307/2530651> and Wesolowska Janczarek (1984) <doi:10.1002/bimj.4710260613>.

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See Also

Useful links:

- Report bugs at https://github.com/pengluyaoyao/MMeM/issues

MMeM_henderson3 *Multivariate Henderson3 method*

Description

Multivariate Henderson3 method

Usage

```
MMeM_henderson3(fml, data, factor_X)
```

Arguments

`fml`	two-sided linear formula object describing both the fixed-effects and random-effects parts of the model, with the response on the left of a ~ operator. For univariate response, put variable name directly; for multivariate responses combine variables using concatenate operator, for example, for bivariate responses, c(var1, var2). The predictor terms are separated by + operators, on the right. Random-effects terms are distinguished by vertical bars '|' separating expressions for design matrices from grouping factors.
`data`	data frame containing the variables named in formula.
`factor_X`	(logical) indicating whether predictor is a factor or continuous. By default is TRUE

Value

The function returns a list with the following objects:

- `T.estimates` is the estimated variance covariance components (T.estimates) of the variance covariance matrix of the block random effects with corresponding sampling variances (T.variance)
- `E.estimates` is the estimated variance covariance components (E.estimates) of the variance covariance matrix of the residuals with corresponding sampling variances (E.variance)

References

Wesolowska Janczarek, M. T. "Estimation of covariance matrices in unbalanced random and mixed multivariate models." Biometrical journal 26.6 (1984): 665,674.

Examples

```
data(simdata)
results_henderson <- MMeM_henderson3(fml = c(V1,V2) ~ X_vec + (1|Z_vec),
data = simdata, factor_X = TRUE)
```

`MMeM_reml` *Multivariate REML Method*

Description

Estimating the variance components under the multivariate mixed effects model using REML methods

Usage

```
MMeM_reml(fml, data, factor_X, T.start, E.start, maxit = 50,
  tol = 1e-09)
```

Arguments

`fml`	a two-sided linear formula object describing both the fixed-effects and random-effects parts of the model, with the response on the left of a ~ operator. For univariate response, put variable name directly; for multivariate responses combine variables using concatenate operator, for example, for bivariate responses, c(var1, var2). The predictor terms are separated by + operators, on the right. Random-effects terms are distinguished by vertical bars 'l' separating expressions for design matrices from grouping factors.
`data`	data frame containing the variables named in formula.
`factor_X`	(logical) indicating whether predictor is a factor or continuous. By default is TRUE
`T.start`	the starting matrix for the variance covariance matrix of the block random effects, it has to be positive definite q by q symmetric matrix.

E.start — the starting matrix for the variance covariance matrix of the block random effects, it has to be positive definite q by q symmetric matrix.

maxit — the maximum number of iterations

tol — the convergence tolerance

Details

Suppose n observational units, q variates, p fixed effects coefficients and s random effects units. The model supports multivariate mixed effects model for one-way randomized block design with equal design matrices:

$$Y = XB + ZU + E$$

where Y is n by q response variates matrix; X is n by p design matrix for the fixed effects; B is p by q coefficients matrix for the fixed effects; Z is n by s design matrix for the random effects; U is s by q matrix for the random effects; E is n by q random errors matrix.

The model also supports simple OLS multivariate regression:

$$y = Xb + Zu + e$$

where y is n by 1 response vector; b is p by 1 coefficients vector for the fixed effects; u is s by 1 matrix for the random effects.

Value

The function returns a list with the following objects:

- `T.estimates` is the estimated variance covariance components of the variance covariance matrix of the block random effects
- `E.estimates` is the estimated variance covariance components of the variance covariance matrix of the residuals
- `VCOV` is the asymptotic dispersion matrix of the estimated variance covariance components for the block random effects and the residuals.

References

Meyer, K. "Maximum likelihood estimation of variance components for a multivariate mixed model with equal design matrices." Biometrics 1985: 153,165.

Examples

```
data(simdata)
T.start <- matrix(c(10,5,5,15),2,2)
E.start <- matrix(c(10,1,1,3),2,2)
results_reml <- MMeM_reml(fml = c(V1,V2) ~ X_vec + (1|Z_vec), data = simdata,
factor_X = TRUE, T.start = T.start, E.start = E.start, maxit = 10)
```

`MMeM_terms` *parses formulas to creates model matrices*

Description

parses formulas to creates model matrices

Usage

```
MMeM_terms(fml, data, factor_X)
```

Arguments

`fml`	a two-sided linear formula object describing both the fixed-effects and random-effects parts of the model, with the response on the left of a ~ operator. For univariate response, put variable name directly; for multivariate responses combine variables using concatenate operator, for example, for bivariate responses, c(var1, var2). The predictor terms are separated by + operators, on the right. Random-effects terms are distinguished by vertical bars 'l' separating expressions for design matrices from grouping factors.
`data`	data frame containing the variables named in formula.
`factor_X`	(logical) indicating whether predictor is a factor or continuous. By default is TRUE

`simdata` *simulated bivariate data*

Description

This is a simulated data with 2 dependent variables and one fixed effects and one random effects

Usage

```
data(simdata)
```

Details

simulated datasets

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