

# Package ‘Mestim’

January 20, 2025

**Type** Package

**Title** Computes the Variance-Covariance Matrix of Multidimensional Parameters Using M-Estimation

**Version** 0.2.1

**Author** François Grolleau

**Maintainer** François Grolleau <francois.grolleau@aphp.fr>

## Description

Provides a flexible framework for estimating the variance-covariance matrix of estimated parameters. Estimation relies on unbiased estimating functions to compute the empirical sandwich variance. (i.e., M-estimation in the vein of Tsiatis et al. (2019) <[doi:10.1201/9780429192692](https://doi.org/10.1201/9780429192692)>).

**Imports** stats

**License** MIT + file LICENCE

**Encoding** UTF-8

**RoxygenNote** 7.2.0

**Suggests** knitr, rmarkdown, boot

**VignetteBuilder** knitr

**NeedsCompilation** no

**Repository** CRAN

**Date/Publication** 2022-12-21 10:20:02 UTC

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**Description**

Provides a flexible framework for estimating the variance-covariance matrix of a multidimensional parameter. Estimation relies on providing unbiased estimating functions to compute the empirical sandwich variance. (i.e., M-estimation in the vein of Tsiatis et al. (2019) <doi:10.1201/9780429192692>).

**Usage**

```
get_vcov(data, thetas, M)
```

**Arguments**

data	a dataframe with proper variable (i.e., column) names.
thetas	a list of the (properly named) estimated parameters.
M	a list of expressions detailing the unbiased estimating functions with the same ordering as thetas. The variables and parameters names in the expressions need be consistent with those of data and thetas.

**Value**

A list with elements vcov, se, and jacob.

vcov	pxp matrix of the estimated asymptotic variance-covariance matrix of the estimated parameters in thetas.
se	length p vector of the estimated asymptotic standard error for the estimated parameters in thetas.
jacob	a list of lists containing expressions for computing the jacobian matrix.

**Author(s)**

François Grolleau <francois.grolleau@aphp.fr>

**References**

Stefanski, L.A. and Boos DD. (2002) *The Calculus of M-Estimation*, *The American Statistician*, doi:10.1198/000313002753631330.

Tsiatis, A. A., Davidian, M., Holloway, S. T. and Laber, E. B (2019) *Dynamic Treatment Regimes: Statistical Methods for Precision Medicine*, CRC Press, doi:10.1201/9780429192692.

**Examples**

```

####
## Simulate data
####
set.seed(123)
n <- 10000 # number of simulated iid observations
x_1 <- rnorm(n); x_2 <- rnorm(n) # generate x_1 and x_2
true_thetas <- c(2,3) # generate true parameters
X <- model.matrix(~-1+x_1+x_2) # build the design matrix
y <- rbinom(n, 1, 1/(1 + exp(-X %*% true_thetas)) ) # generate Y from X and true_thetas
dat <- data.frame(x_1=x_1, x_2=x_2, y=y) # build a simulated dataset

####
## Fit a LR model (estimated parameters solve unbiased estimating equations)
####

mod <- glm(y~-1 + x_1 + x_2, data=dat, family = "binomial")

####
## Get variance covariance matrix for all parameters solving unbiased estimating equations
####

# Put estimated parameters in a list
thetas_hat <- list(theta_1=coef(mod)[1], theta_2=coef(mod)[2])

# Build a list of unbiased estimating functions
# NB: parameters' names must be consistent with the previous list
psi_1 <- expression( ((1/(1+exp( -( theta_1 * x_1 + theta_2 * x_2 ) ))) - y ) * x_1 )
psi_2 <- expression( ((1/(1+exp( -( theta_1 * x_1 + theta_2 * x_2 ) ))) - y ) * x_2 )
est_functions <- list(psi_1, psi_2)

## Pass arguments and run get_vcov
res <- get_vcov(data=dat, thetas=thetas_hat, M=est_functions)

# Estimated variance covariance matrix is similar to that obtain from glm
res$vcov
vcov(mod)

# So are the standard errors for the estimated parameters
res$se
summary(mod)$coefficients[,2]

```

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