R documentation

of ‘cfisher.Rd’

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cfisher *Auto-constructing Fisher Information matrix*

Description

Auto-constructs Fisher information matrix for nonlinear and generalized linear models as two R functions.

Usage

```
cfisher(ymean, yvar, ndpoints, prec = 53)
```

Arguments

ymean	a character string, formula of $E(y)$ with specific satndard: characters b1, b2, b3, ... symbolize model parameters and x1, x2, x3, ... symbolize explanatory variables. See ’Examples’.
yvar	a character string, formula of $Var(y)$ with specific standard as ymean. See ’Details’ and ’Examples’.
ndpoints	number of design points.
prec	(optional) a number, the maximal precision to be used for D-efficiency calculation, in bite. Must be at least 2 (default 53).

Details

If response variables have the same constant variance, for example σ^2, then yvar must be 1.

Value

a list containing two closures:

fim	a function in which its arguments are vector of design points (x), vector of corresponding weights (w) and vector of parameters (β) and its output is Fisher information matrix.
fim.mpfr	a function in which its arguments are vector of design points (x), vector of corresponding weights (w) and vector of parameters (β) and its output is Fisher information matrix of class ’mpfrMatrix’.

For more details, see ’Note’.

Note

This function is applicable for models that can be written as $E(Y_i) = f(x_i, \beta)$ where y_i is the ith response variable, x_i is the observation vector of the ith explanatory variables, β is the vector of parameters and f is a continuous and differentiable function with respect to β. In addition, response variables must be independent with distributions that belong to the Natural exponential family. Logistic,Poisson, Negative Binomial, Exponential, Richards, Weibull, Log-linear, Inverse Quadratic and Michaelis-Menten are examples of these models.

Consider a p-parameter model and a design ξ that contains n m-dimensional points. Then

$$x = (x_1, x_2, \ldots, x_i, \ldots, x_n),$$

$$w = (w_1, w_2, \ldots, w_n),$$

$$\beta = (\beta_1, \beta_2, \ldots, \beta_p),$$

where $x_i = (x_{i1}, x_{i2}, \ldots, x_{im})$ is the ith design point.

Author(s)

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References

Masoudi, E., Sarmad, M. and Talebi, H. 2012, An Almost General Code in R to Find Optimal Design, In Proceedings of the 1st ISM International Statistical Conference 2012, 292-297.

Examples

```
## Logistic dose response model
ymean <- "(1/(exp(-b2 * (x1 - b1)) + 1))"
yvar <- "(1/(exp(-b2 * (x1 - b1)) + 1)) * (1 - (1/(exp(-b2 * (x1 - b1)) + 1)))"
res <- cfisher(ymean, yvar, ndpoints = 2, prec = 54)

# res$fim is Fisher information matrix for a two-points design
res$fim(x = c(x11 = 2, x21 = 3), w = c(w1 = .5, w2 = .5), b = c(b1 = .9, b2 = .8))

# res$fim is Fisher information matrix for a two-points design with 54 precision
res$fim.mpfr(x = c(x11 = 2, x21 = 3), w = c(w1 = .5, w2 = .5), b = c(b1 = .9, b2 = .8))

# Fisher information matrix for model:
fim<- cfisher(ymean, yvar, ndpoints = 1, prec = 54)
res$fim(x = c(x11 = 2), w = c(w1 = 1), b = c(b1 = .9, b2 = .8))

## posison with E(y) = exp(b1 + b2 * x1 + b3 * x1^2 + b4 * x2 +b5 * x2^2 + b6 * x1 * x2)
ymean <- yvar <- "exp(b1 + b2 * x1 + b3 * x1^2 + b4 * x2 +b5 * x2^2 + b6 * x1 * x2)"
fim <- cfisher(ymean, yvar, ndpoints = 6, prec = 54)

# res$fim is Fisher information matrix for a six-points design
res$fim(x = c(1:12), w = rep(1/6, 6), b = c(1:6)) ## NAN

# res$fim.mpfr is Fisher information matrix for a six-points design with 53 precision
res$fim.mpfr(x = c(1:12), w = rep(1/6, 6), b = c(1:6))

## Linear regression with two indeoendent varibales (the design points are two-dimensional)
ymean <- "b1 + b2 * x1 + b3 * x2"
yvar = "1"
```

```
res <- cfisher(ymean, yvar, ndpoints = 3, prec = 54)
res$fim(x = c(1:6), w = c(.3, .3, .3))
res$fim.mpfr(x = c(1:6), w = c(.3, .3, .3))

## Logistic model:
ymean <- "1/(exp(-b1 - b2 * x1) + 1)"
yvar <- "(1/(exp(-b1 - b2 * x1) + 1)) * (1 - (1/(exp(-b1 - b2 * x1) + 1)))"
cfisher(ymean, yvar, ndpoints = 2, prec = 54)

## Poisson model:
ymean <- yvar <-  "exp(b1 + b2 * x1)"
cfisher(ymean, yvar, ndpoints = 2, prec = 54)

## Poisson dose response model:
ymean <- yvar <- "b1 * exp(-b2 * x1)"
cfisher(ymean, yvar, ndpoints = 2, prec = 54)

## Inverse Quadratic model:
ymean <- "(b1 * x1)/(b2 + x1 + b3 * (x1)^2)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 3, prec = 54)
#
ymean <- "x1/(b1 + b2 * x1 + b3 * (x1)^2)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 3, prec = 54)

## Weibull model:
ymean <- "b1 - b2 * exp(-b3 * x1^b4)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 4, prec = 54)

## Richards model:
ymean <- "b1/(1 + b2 * exp(-b3 * x1))^b4"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 4, prec = 54)

## Michaelis-Menten model:
ymean <- "(b1 * x1)/(1 + b2 * x1)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 2, prec = 54)
#
ymean <- "(b1 * x1)/(b2 + x1)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 2, prec = 54)
#
ymean <- "x1/(b1 + b2 * x1)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 2, prec = 54)

## log-linear model
ymean <- "b1 + b2 * log(x1 + b3)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 3, prec = 54)

## Exponential model:
ymean <- "b1 + b2 * exp(x1/b3)"
yvar <- "1"
```

```
cfisher(ymean, yvar, ndpoints = 3, prec = 54)

## Emax model:
ymean  <- "b1 + (b2 * x1)/(x1 + b3)"
yvar <- "1"
cfisher(ymean, yvar, ndpoints = 3, prec = 54)

## Negative binomial model Y ~ NB(E(Y), theta) where E(Y) = b1*exp(-b2*x1):
theta = 5
ymean <- "b1 * exp(-b2 * x1)"
yvar <- paste("b1 * exp(-b2 * x1) * (1 + (1/", theta, ") * b1 * exp(-b2 * x1))", sep = "")
cfisher(ymean, yvar, ndpoints = 3, prec = 54)
```

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