Package: ggmr (via r-universe)

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Type Package

Title Generalized Gauss Markov Regression

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Author Hugo Gasca-Aragon

Maintainer Hugo Gasca-Aragon <hugo_gasca_aragon@hotmail.com>

Description Implements the generalized Gauss Markov regression, this is useful when both predictor and response have uncertainty attached to them and also when covariance within the predictor, within the response and between the predictor and the response is present. Base on the results published in guide ISO/TS 28037 (2010) <https://www.iso.org/standard/44473.html>.

Depends stats (>= 3.4.0), MASS (>= 7.3), R (>= 3.4.0)

License GPL (>= 2)

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ggmr *Solves the Generalized Gauss Markov Regression model*

Description

Fits the linear model using covariance matrices on the predictor, the response and covariance matrix between predictor and response, according to ISO/TS 28037 (2010).

Usage

```
ggmr(x, y, Ux = diag(0, length(x)),
   Uy = diag(1, length(x)),
   Uxy = diag(0, length(x)),
   subset = rep(TRUE, length(x)),
   tol = sqrt(.Machine$double.eps), max.iter = 100, alpha = 0.05,
   coef.H0 = c(0, 1))
```

Arguments

`x`	numeric vector, the predictor values
`y`	numeric vector, the response values
`Ux`	numeric matrix, the variance matrix of the predictor
`Uy`	numeric matrix, the variance matrix of the response
`Uxy`	numeric matrix, the covariance matrix between predictor and the response
`subset`	a logical vector or a numeric vector with the position to be considered
`tol`	numeric, the maximum allowed error tolerance, tolerance is relative
`max.iter`	integer, the maximum number of allowed iterations
`alpha`	numeric, the significance level used on testing H0
`coef.H0`	the coeffients for hypothesis testing purposes

Value

a list with the following elements

`coefficients`	estimated coefficients
`cov`	covariance matrix of the estimated coefficients
`xi`	estimated latent unobservable variables
`chisq.validation`	chi-squared statistic for model validation
`chisq.ht`	chi-squared statistic of the observed values for the hypothesis testing
`chisq.cri`	chi-squared critical value
`p.value`	probability of observing a validation statistic equal or larger then the sampled just by chance
`curr.iter`	current number of iterations used
`curr.tol`	current relative tolerance

Author(s)

Hugo Gasca-Aragon

Maintainer: Hugo Gasca-Aragon <hugo_gasca_aragon@hotmail.com>

References

ISO/TS 28037 (2010). *Determination and Use of straight-line calibration functions* https://www.iso.org/standard/44473.html

See Also

lm, dwlm

Examples

```
require(MASS)

# Example ISO 28037 (2010) Section 6. table 6
d<- data.frame(
 x=c(1.0, 2.0, 3.0, 4.0, 5.0, 6.0),
 y=c(3.2, 4.3, 7.6, 8.6, 11.7, 12.8),
 uy=c(0.5, 0.5, 0.5, 1.0, 1.0, 1.0)
)
# estimates
ggmr.res <- ggmr(d$x, d$y, Uy=diag(d$uy^2), coef.H0=c(0, 2), tol = 1e-10)
ggmr.res$coefficients
sqrt(diag(ggmr.res$cov))
ggmr.res$cov[1, 2]
ggmr.res$chisq.validation
ggmr.res$chisq.cri
# reference values
# coefficients = c(0.885, 2.057)
# se = c(0.530, 0.178)
# cov = -0.082
# validation.stat = 4.131
# critical.value = 9.488

# lm() estimates the coefficients correctly but
# fails to reproduce the standard errors
summary(lm(y~x, data=d, weights=1/d$uy^2))
# coefficients = c(0.8852, 2.0570)
# se = c(0.5383, 0.1808)

# Example ISO 28037 (2010) Section 7. table 10
d <- data.frame(
 x = c(1.2, 1.9, 2.9, 4.0, 4.7, 5.9),
 y = c(3.4, 4.4, 7.2, 8.5, 10.8, 13.5)
)
Ux = diag(c(0.2, 0.2, 0.2, 0.2, 0.2, 0.2))^2
Uy = diag(c(0.2, 0.2, 0.2, 0.4, 0.4, 0.4))^2
```

```
# estimates
ggmr.res <- ggmr(d$x, d$y, Ux, Uy, coef.H0=c(0, 2), tol = 1e-10)
ggmr.res$coefficients
sqrt(diag(ggmr.res$cov))
ggmr.res$cov[1, 2]
ggmr.res$chisq.validation
ggmr.res$chisq.cri
# reference values
# coefficients = c(0.5788, 2.1597)
# se = c(0.4764, 0.1355)
# cov = -0.0577
# validation.stat = 2.743
# critical.value = 9.488

# Example ISO 28037 (2010) Section 10. table 25
d<- data.frame(
 x=c(50.4, 99.0, 149.9, 200.4, 248.5, 299.7, 349.1),
 y=c(52.3, 97.8, 149.7, 200.1, 250.4, 300.9, 349.2)
)

Ux<- matrix(c(
 0.50, 0.00, 0.25, 0.00, 0.25, 0.00, 0.25,
 0.00, 1.25, 1.00, 0.00, 0.00, 1.00, 1.00,
 0.25, 1.00, 1.50, 0.00, 0.25, 1.00, 1.25,
 0.00, 0.00, 0.00, 1.25, 1.00, 1.00, 1.00,
 0.25, 0.00, 0.25, 1.00, 1.50, 1.00, 1.25,
 0.00, 1.00, 1.00, 1.00, 1.00, 2.25, 2.00,
 0.25, 1.00, 1.25, 1.00, 1.25, 2.00, 2.50
), 7, 7)

Uy<- matrix(1.00, 7, 7) + diag(4.00, 7)

Uxy<- matrix(0, 7, 7)

# estimates
ggmr.res<- ggmr(d$x, d$y, Ux, Uy, Uxy)
ggmr.res$coefficients
sqrt(diag(ggmr.res$cov))
ggmr.res$cov[1, 2]
ggmr.res$chisq.validation
ggmr.res$chisq.cri
# reference values
# coefficients = c(0.3424, 1.0012)
# se = c(2.0569, 0.0090)
# cov = -0.0129
# validation.stat = 1.772
# critical.value = 11.070
```

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