

Package ‘frm’

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Title Regression Analysis of Fractional Responses

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Description Estimation and specification analysis of one- and two-part fractional regression models and calculation of partial effects.

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frm-package	<i>Regression Analysis of Fractional Responses</i>
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Description

Estimation and specification analysis of one- and two-part fractional regression models and calculation of partial effects.

Details

Package: frm
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Author(s)

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References

Ramalho, E.A., J.J.S. Ramalho and J.M.R. Murteira (2011), "Alternative estimating and testing empirical strategies for fractional regression models", *Journal of Economic Surveys*, 25(1), 19-68.

frm

Fitting Fractional Regression Models

Description

frm is used to fit fractional regression models, i.e. regression models for proportions, percentages or fractions.

Usage

```
frm(y, x, x2 = x, linkbin, linkfrac, type = "1P", inflation = 0, intercept = T,
    table = T, variance = T, var.type = "default", var.eim = T, var.cluster,
    dfc = F, ...)
```

Arguments

y	a numeric vector containing the values of the response variable.
x	a numeric matrix, with column names, containing the values of the covariates.
x2	a numeric matrix, with column names, containing the values of the covariates in the fractional component of two-part models if option type = "2P" is defined. Defaults to x.
linkbin	a description of the link function to use in the binary component of a two-part fractional regression model. Available options: logit, probit, cauchit, loglog, cloglog.
linkfrac	a description of the link function to use in standard fractional regression models or in the fractional component of a two-part fractional regression model. Available options: logit, probit, cauchit, loglog, cloglog.

<code>type</code>	a description of the model to estimate: a standard one-part model (1P, the default), a two-part model (2P), the binary component of a two-part model (2Pbin) or the fractional component of a two-part model (2Pfrac).
<code>inflation</code>	a numeric value indicating which of the extreme values of 0 (the default) or 1 is the relevant boundary value for defining two-part fractional regression models.
<code>intercept</code>	a logical value indicating whether the model should include a constant term or not.
<code>table</code>	a logical value indicating whether a summary table with the regression results should be printed.
<code>variance</code>	a logical value indicating whether the variance of the estimated parameters should be calculated. Defaults to TRUE whenever <code>table = TRUE</code> .
<code>var.type</code>	a description of the type of variance of the estimated parameters to be calculated. Options are <code>standard</code> (recommended for models estimated by maximum likelihood, such as the binary component of two-part models), <code>robust</code> (recommended for models estimated by quasi-maximum likelihood, such as standard fractional regression models or the fractional component of a two-part fractional regression model), <code>cluster</code> (recommended in the case of panel data) and <code>default</code> (implements the standard or robust versions as appropriate).
<code>var.eim</code>	a logical value indicating whether the expected information matrix should be used in the calculation of the variance. When false, the observation information matrix will be used. Defaults to TRUE.
<code>var.cluster</code>	a numeric vector containing the values of the variable that specifies to which cluster each observation belongs.
<code>dfc</code>	a logical value indicating whether a degrees of freedom correction should be applied to the covariance matrix. Defaults to FALSE.
<code>...</code>	Arguments to pass to <code>glm</code> .

Details

`frm` estimates one- and two-part fractional regression models; see Ramalho, Ramalho and Murteira (2011) for details on those models. The one-part models and the fractional component of two-part models are estimated by Bernoulli-based quasi-maximum likelihood, while the binary component of two-part models is estimated by maximum likelihood. `frm` uses the standard `glm` command to perform the estimations. Therefore, `frm` is essentially a convenience command, allowing estimation of several alternative fractional regression models using the same command. In addition, `frm` provides an R-squared measure for all models (calculated as the square of the correlation coefficient between the actual and fitted values of the dependent variable), calculates the fitted values of the dependent variable in two-part models and stores the information needed to implement some very useful commands for fractional regression models: `frm.reset` (RESET test), `frm.ptest` (P test), `frm.ggoff` (GGOFF tests) and `frm.pe` (partial effects).

Value

When `type = "1P"` or `"2Pfrac"`, `frm` returns a list with the following elements:

```
class      "frm".
```

formula	the model formula.
type	the name of the estimated model.
link	the name of the specified link.
method	estimation method. Currently, "QML" (quasi-maximum likelihood) for fractional components or models and "ML" (maximum likelihood) for the binary component of two-part models.
p	a named vector of coefficients.
yhat	the fitted mean values.
xbhat	the fitted mean values of the linear predictor.
converged	logical. Was the algorithm judged to have converged?
x.names	a vector containing the names of the covariates.

If `variance = TRUE` or `table = TRUE`, the previous list also contains the following elements:

p.var	a named covariance matrix.
var.type	covariance matrix type.
var.eim	logical. Was the expected information matrix used in the computation of the covariance matrix?
dfc	logical. Was a degrees of freedom correction used for the computation of the covariance matrix?

If `var.type = "cluster"`, the list also contains the following element:

var.cluster	the variable that specifies to which cluster each observation belongs.
-------------	--

When `type = "2Pbin"`, `frm` returns a similar list with the following additional element:

LL	the value of the log-likelihood.
----	----------------------------------

When `type = "2P"`, `frm` returns the previous lists, indexed by the prefixes `resBIN` and `resFRAC`, and the following additional elements:

class	"frm".
type	"2P".
ybase	a numeric vector containing the values of the response variable.
x2base	a numeric matrix containing the values of the covariates.
yhat2P	the overall fitted mean values.
converged	logical. Were the algorithms judged to have converged in both parts of the model?

Author(s)

Joaquim J.S. Ramalho <jsr@uevora.pt>

References

Ramalho, E.A., J.J.S. Ramalho and J.M.R. Murteira (2011), "Alternative estimating and testing empirical strategies for fractional regression models", *Journal of Economic Surveys*, 25(1), 19-68.

See Also

[frm.reset](#) and [frm.ggoff](#), for specification tests.
[frm.ptest](#), for non-nested hypothesis tests.
[frm.pe](#), for computing partial effects.
[frmhet](#), for fitting cross-sectional fractional regression models with unobserved heterogeneity.
[frmpd](#), for fitting panel data fractional regression models.

Examples

```

N <- 250
u <- rnorm(N)

X <- cbind(rnorm(N),rnorm(N))
dimnames(X)[[2]] <- c("X1", "X2")

ym <- exp(X[,1]+X[,2]+u)/(1+exp(X[,1]+X[,2]+u))
y <- rbeta(N,ym*20,20*(1-ym))
y[y > 0.9] <- 1

#frm estimation of a logit fractional regression model
frm(y,X,linkfrac="logit")

#frm estimation of the binary logit component of the two-part fractional
#regression model with y=1 as the relevant boundary value
frm(y,X,linkbin="logit",type="2Pbin",inf=1)

#frm estimation of the fractional component of the two-part fractional
#regression model with y=1 as the relevant boundary value and using a
#probit link function
frm(y,X,linkfrac="probit",type="2Pfrac",inf=1)

#frm estimation of both components of a two-part fractional regression model
#with y=1 as the relevant boundary value and using a cloglog binary link
#function and a logit fractional link function
frm(y,X,linkbin="cloglog",linkfrac="logit",type="2P",inf=1)

## See the website http://evunix.uevora.pt/~jsr/FRM.htm for more examples.

```

frm.ggoff

GGOFF Tests for Fractional Regression Models

Description

frm.ggoff is used to test the specification of fractional regression models.

Usage

```
frm.ggoff(object, version = "LM", table = T, ...)
```

Arguments

object	an object containing the results of an <code>frm</code> command.
version	a vector containing the test versions to use. Available options: Wald, LM (the default) and, only for the binary component of two-part models, LR. More than one option may be chosen.
table	a logical value indicating whether a summary table with the test results should be printed.
...	Arguments to pass to <code>glm</code> , which is used to estimate the model under the alternative hypothesis when <code>version</code> is a vector containing "Wald" or "LR".

Details

`frm.ggoff` applies the GGOFF, GOFF1 and GOOFF2 test statistics to fractional regression models estimated via `frm`. `frm.ggoff` may be used to test the link specification of: (i) one-part fractional regression models; (ii) the binary component of two-part fractional regression models; and (iii) the fractional component of two-part fractional regression models. When the Wald version is implemented, it is taken into account the option that was chosen for computing standard errors in the model under evaluation. For the LM version, a robust version is computed in cases (i) and (iii) and a conventional version in case (ii). See Ramalho, Ramalho and Murteira (2014) for details on the application of the GGOFF, GOFF1 and GOOFF2 tests in the fractional regression framework.

Value

`frm.ggoff` returns a named vector with the test results.

Author(s)

Joaquim J.S. Ramalho <jsr@uevora.pt>

References

Ramalho, E.A., J.J.S. Ramalho and J.M.R. Murteira (2014), "A generalized goodness-of-functional form test for binary and fractional regression models", *Manchester School*, 82(4), 488-507.

See Also

[frm](#), for fitting fractional regression models.
[frm.reset](#), for asymptotically equivalent specification tests.
[frm.ptest](#), for non-nested hypothesis tests.
[frm.pe](#), for computing partial effects.

Examples

```
N <- 250
u <- rnorm(N)

X <- cbind(rnorm(N), rnorm(N))
dimnames(X)[[2]] <- c("X1", "X2")
```

```

ym <- exp(X[,1]+X[,2]+u)/(1+exp(X[,1]+X[,2]+u))
y <- rbeta(N,ym*20,20*(1-ym))
y[y > 0.9] <- 1

#Testing the logit specification of a standard fractional regression model
#using LM and Wald versions of the GGOF test, based on 1 or 2 fitted powers of
#the linear predictor
res <- frm(y,X,linkfrac="logit",table=FALSE)
frm.ggoff(res,c("Wald","LM"))

#Testing the probit specification of the binary component of a two-part fractional
#regression model using a LR-based GGOF test
res <- frm(y,X,linkbin="probit",type="2Pbin",inf=1,table=FALSE)
frm.ggoff(res,"LR")

## See the website http://evunix.uevora.pt/~jsr/FRM.htm for more examples.

```

frm.pe

Fractional Regression Models - Partial Effects

Description

frm.pe is used to compute average and/or conditional partial effects in fractional regression models.

Usage

```
frm.pe(object, APE = T, CPE = F, at = NULL, which.x = NULL, variance = T, table = T)
```

Arguments

object	an object containing the results of an frm command.
APE	a logical value indicating whether average partial effects are to be computed.
CPE	a logical value indicating whether conditional partial effects are to be computed.
at	a numeric vector containing the covariates' values at which the conditional partial effects are to be computed or the strings "mean" (the default) or "median", in which cases the covariates are evaluated at their mean or median values (or mode, in case of dummy variables), respectively.
which.x	a vector containing the names of the covariates to which the partial effects are to be computed.
variance	a logical value indicating whether the variance of the estimated partial effects should be calculated. Defaults to TRUE whenever table = TRUE.
table	a logical value indicating whether a summary table with the results should be printed.

Details

frm.pe calculates partial effects for fractional regression models estimated via frm. frm.pe may be used to compute average or conditional partial effects for: (i) one-part fractional regression models; (ii) the binary component of two-part fractional regression models; (iii) the fractional component of two-part fractional regression models; and (iv) two-part fractional regression models. For calculating standard errors, it is taken into account the option that was previously chosen for estimating the model. See Ramalho, Ramalho and Murteira (2011) for details on the computation of partial effects in the fractional regression framework.

Value

frm.pe returns a list with the following element:

PE.p a named vector of partial effects.

If variance = TRUE or table = TRUE, the previous list also contains the following element:

PE.sd a named vector of standard errors of the estimated partial effects.

When both average and conditional partial effects are requested, two lists containing the previous elements are returned, indexed by the prefixes ape and cpe.

Author(s)

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References

Ramalho, E.A., J.J.S. Ramalho and J.M.R. Murteira (2011), "Alternative estimating and testing empirical strategies for fractional regression models", *Journal of Economic Surveys*, 25(1), 19-68.

See Also

[frm](#), for fitting fractional regression models.
[frm.reset](#) and [frm.ggoff](#), for specification tests.
[frm.ptest](#), for non-nested hypothesis tests.

Examples

```
N <- 250
u <- rnorm(N)

X <- cbind(rnorm(N), rnorm(N))
dimnames(X)[[2]] <- c("X1", "X2")

ym <- exp(X[,1]+X[,2]+u)/(1+exp(X[,1]+X[,2]+u))
y <- rbeta(N, ym*20, 20*(1-ym))
y[y > 0.9] <- 1

#Computing average partial effects for a logit fractional regression model
res <- frm(y,X,linkfrac="logit",table=FALSE)
```



```

frm.pe(res)

#Computing average partial effects for a binary logit + fractional probit
#two-part model
res <- frm(y,X,linkbin="logit",linkfrac="probit",type="2P",inf=1,table=FALSE)
frm.pe(res)

#Computing conditional partial effects for X2 in the logit component
#of a two-part fractional regression model, with the covariates evaluated
#at their median values
res <- frm(y,X,linkfrac="logit",type="2Pfrac",inf=1,table=FALSE)
frm.pe(res,APE=FALSE,CPE=TRUE,at="median",which.x="X2")

## See the website http://evunix.uevora.pt/~jsr/FRM.htm for more examples.

```

frm.ptest

P Test for Fractional Regression Models

Description

frm.ptest is used to test the specification of alternative non-nested fractional regression models.

Usage

```
frm.ptest(object1, object2, version = "Wald", table = T)
```

Arguments

object1	an object containing the results of an frm command.
object2	an object containing the results of another frm command.
version	a vector containing the test versions to use. Available options: Wald (the default) and LM. Both options may be chosen at the same time and are computed in a robust way.
table	a logical value indicating whether a summary table with the test results should be printed.

Details

frm.ptest applies the P test statistic proposed by Davidson and MacKinnon (1981) to fractional regression models estimated via frm. frm.ptest may be used to test against each other two alternative specifications for the link function in: (i) one-part fractional regression models; (ii) the binary component of two-part fractional regression models; (iii) the fractional component of two-part fractional regression models; and (iv) two-part fractional regression models. In addition, frm.ptest may be used to test one-part models against two-part models and in cases where the link functions are the same but the regressors are non-nested. See Ramalho, Ramalho and Murteira (2011) for details on the application of the P test in the fractional regression framework.

Value

frm.reset returns a named vector with the test results.

Author(s)

Joaquim J.S. Ramalho <jsr@uevora.pt>

References

Davidson, R. and J.G. MacKinnon (1981), "Several tests for model specification on the presence of alternative hypotheses", *Econometrica*, 49(3), 781-793.

Ramalho, E.A., J.J.S. Ramalho and J.M.R. Murteira (2011), "Alternative estimating and testing empirical strategies for fractional regression models", *Journal of Economic Surveys*, 25(1), 19-68.

See Also

[frm](#), for fitting fractional regression models.
[frm.reset](#) and [frm.ggoff](#), for specification tests.
[frm.pe](#), for computing partial effects.

Examples

```
N <- 250
u <- rnorm(N)

X <- cbind(rnorm(N), rnorm(N))
dimnames(X)[[2]] <- c("X1", "X2")

ym <- exp(X[,1]+X[,2]+u)/(1+exp(X[,1]+X[,2]+u))
y <- rbeta(N, ym*20, 20*(1-ym))
y[y > 0.9] <- 1

#Testing logit versus loglog specifications for standard fractional
#regression models using a LM version of the P test
res1 <- frm(y,X,linkfrac="logit",table=FALSE)
res2 <- frm(y,X,linkfrac="loglog",table=FALSE)
frm.ptest(res1,res2,"LM")

#Testing a logit one-part fractional regression model versus a binary logit +
#fractional probit two-part model using a Wald version of the P test
res1 <- frm(y,X,linkfrac="logit",table=FALSE)
res2 <- frm(y,X,linkbin="logit",linkfrac="probit",type="2P",inf=1,table=FALSE)
frm.ptest(res1,res2,"Wald")

## See the website http://evunix.uevora.pt/~jsr/FRM.htm.
```

frm.reset	<i>RESET Test for Fractional Regression Models</i>
-----------	--

Description

frm.reset is used to test the specification of fractional regression models.

Usage

```
frm.reset(object, lastpower.vec = 3, version = "LM", table = T, ...)
```

Arguments

object	an object containing the results of an frm command.
lastpower.vec	a numeric vector containing the maximum powers of the linear predictors to be used in RESET tests.
version	a vector containing the test versions to use. Available options: Wald, LM (the default) and, only for the binary component of two-part models, LR. More than one option may be chosen.
table	a logical value indicating whether a summary table with the test results should be printed.
...	Arguments to pass to glm , which is used to estimate the model under the alternative hypothesis when version is a vector containing "Wald" or "LR".

Details

frm.reset applies the RESET test statistic to fractional regression models estimated via frm. frm.reset may be used to test the link specification of: (i) one-part fractional regression models; (ii) the binary component of two-part fractional regression models; and (iii) the fractional component of two-part fractional regression models. When the Wald version is implemented, it is taken into account the option that was chosen for computing standard errors in the model under evaluation. For the LM version, a robust version is computed in cases (i) and (iii) and a conventional version in case (ii). See Ramalho, Ramalho and Murteira (2011) for details on the application of the RESET test in the fractional regression framework.

Value

frm.reset returns a named vector with the test results.

Author(s)

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References

Ramalho, E.A., J.J.S. Ramalho and J.M.R. Murteira (2011), "Alternative estimating and testing empirical strategies for fractional regression models", *Journal of Economic Surveys*, 25(1), 19-68.

See Also

[frm](#), for fitting fractional regression models.
[frm.ggoff](#), for asymptotically equivalent specification tests.
[frm.ptest](#), for non-nested hypothesis tests.
[frm.pe](#), for computing partial effects.

Examples

```

N <- 250
u <- rnorm(N)

X <- cbind(rnorm(N),rnorm(N))
dimnames(X)[[2]] <- c("X1","X2")

ym <- exp(X[,1]+X[,2]+u)/(1+exp(X[,1]+X[,2]+u))
y <- rbeta(N,ym*20,20*(1-ym))
y[y > 0.9] <- 1

#Testing the logit specification of a standard fractional regression model
#using LM and Wald versions of the RESET test, based on 1 or 2 fitted powers of
#the linear predictor
res <- frm(y,X,linkfrac="logit",table=FALSE)
frm.reset(res,2:3,c("Wald","LM"))

#Testing the probit specification of the binary component of a two-part fractional
#regression model using LR-based RESET tests with quadratic and cubic fitted
#powers of the linear predictor
res <- frm(y,X,linkbin="probit",type="2Pbin",inf=1,table=FALSE)
frm.reset(res,3,"LR")

## See the website http://evunix.uevora.pt/~jsr/FRM.htm for more examples.

```

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