Package 'gwer'

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Description Computes a elliptical regression model or a geographically weighted regression model with elliptical errors using Fisher's score algorithm. Provides diagnostic measures, residuals and analysis of variance. Cysneiros, F. J. A., Paula, G. A., and Galea, M. (2007) <doi:10.1016/j.spl.2007.01.012>.

Depends R (>= 2.14), sp (>= 0.8-3), stats

Imports maptools (>= 0.7-32), Matrix, methods, spData (>= 0.2.6.2), spdep, spgwr, utils, assertthat, glogis, graphics

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R topics documented:

`anova.elliptical` *Analysis of Deviance for Elliptical Model Fits*

Description

Compute an analysis of deviance table for the fitted elliptical regression model.

Usage

```
## S3 method for class 'elliptical'
anova(object, ..., dispersion = NULL,
  test = c("Chisq"))
```

Arguments

`object`	an object with the result of the fitted elliptical regression model.
`...`	additional objects of the same type.
`dispersion`	the dispersion parameter for the fitting family. If is `NULL` (by default) is obtained from object.
`test`	a character string containing the hypothesis test considered. By default is used the chi-square test.

Value

Return an object of class "anova". This object contain the analysis of deviance.

References

Cysneiros, F. J. A., Paula, G. A., and Galea, M. (2007). Heteroscedastic symmetrical linear models. Statistics & probability letters, 77(11), 1084-1090. https://doi.org/10.1016/j.spl.2007.01.012

See Also

`elliptical`, `summary.elliptical`, `family.elliptical`

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5),
data=luz)
anova(elliptical.fitt, test = "Chisq")
```

`elliptical` *Elliptical Regression Models*

Description

The function implements linear elliptical regression models. This models is specified giving a symbolic description of the systematic and stochastic components.

Usage

```
elliptical(formula = formula(data), family = Normal,
  data = sys.parent(), dispersion = NULL, weights, subset,
  na.action = "na.fail", method = "elliptical.fit",
  control = glm.control(epsilon = 1e-04, maxit = 100, trace = F),
  model = F, x = F, y = T, contrasts = NULL, offset, ...)
```

Arguments

`formula`	regression model formula as in `glm`.
`family`	a description of the error distribution to be used in the model (see `elliptical.family` for details of family functions).
`data`	an optional data frame, list or environment containing the variables in the model.
`dispersion`	an optional fixed value for dispersion parameter.
`weights`	an optional numeric vector of weights to be used in the fitting process.
`subset`	an optional numeric vector specifying a subset of observations to be used in the fitting process.
`na.action`	a function which indicates what should happen when the data contain NAs (see `glm`).
`method`	optimization method used to estimate the parameters. The default method "elliptical.fit" uses Fisher's scoring method. The alternative "model.frame" returns the model frame and does no fitting.
`control`	a list of parameters for controlling the fitting process. For `elliptical` this is passed by `glm.control`.

model	a logical value indicating whether model frame should be included as a component of the return.
x	a logical value indicating whether the response vector used in the fitting process should be returned as components of the return.
y	a logical value indicating whether model matrix used in the fitting process should be returned as components of the return.
contrasts	an optional list. See the contrasts.arg of model.matrix.default.
offset	this can be used to specify an a priori known component to be included in the linear predictor during fitting as in glm.
...	arguments to be used to form the default control argument if it is not supplied directly.

Value

returns an object of class "elliptical", a list with follow components:

coefficients	coefficients of location parameters.
dispersion	coefficient of dispersion parameter.
residuals	standardized residuals.
fitted.values	the fitted mean values.
loglik	the likelihood logarithm value for the fitted model.
Wg	values of the function W_g(u).
Wgder	values for the function W^{(1)}_g(u).
v	values for the function V(u).
rank	the numeric rank for the fitted model.
R	the matrix of correlation for the estimated parameters.
inter	number of iterations of optimization process.
scale	values of the 4d_g for the specified distribution.
scaledispersion	values of the 4f_g for the specified distribution.
scalevariance	values of the scale variance for the specified distribution.
df	degree of freedom for t-student distribution.
s, r	shape parameters for generalized t-student distribution.
alpha	shape parameter for contaminated normal and generalized logistic distributions.
mp	shape parameter for generalized logistic distribution.
epsi,sigmap	dispersion parameters for contaminated normal distribution.
k	shape parameter for power exponential distribution.
Xmodel	the model matrix.
weights	the working weights, that is the weights in the final iteration of optimization process
df.residuals	the residual degrees of freedom.

family	the family object used.
formula	the formula supplied.
terms	the terms object used.
contrasts	(where relevant) the contrasts used.
control	the value of the control argument used.
call	the matched call.
y	the response variable used.

References

Cysneiros, F. J. A., Paula, G. A., and Galea, M. (2007). Heteroscedastic symmetrical linear models. Statistics & probability letters, 77(11), 1084-1090. https://doi.org/10.1016/j.spl.2007.01.012

Fang, K. T., Kotz, S. and NG, K. W. (1990, ISBN:9781315897943). Symmetric Multivariate and Related Distributions. London: Chapman and Hall.

See Also

glm, family.elliptical, summary.elliptical

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5)
,data=luz)
elliptical.fitLII <- elliptical(y ~ x1+x2+x3, family = LogisII()
,data=luz)
```

---

elliptical.diag *Diagnostic for Elliptical Regression Models*

Description

This function obtains the values of differents residuals types and calculates the diagnostic measures for the fitted elliptical regression model.

Usage

```
elliptical.diag(object, ...)
```

Arguments

`object`	an object with the result of the fitted elliptical regression model.
`...`	arguments to be used to form the default control argument if it is not supplied directly.

Value

Returns a list of diagnostic arrays:

`ro`	Ordinal residuals.
`rr`	Response residuals.
`rp`	Pearson residuals.
`rs`	Studentized residuals.
`rd`	Deviance residuals.
`dispersion`	Coefficient of dispersion.
`H`	The hat matrix.
`h`	Main diagonal of the hat matrix.
`GL`	Generalized leverage.
`GLbeta`	Generalized leverage of location parameters estimation.
`GLphi`	Generalized leverage of dispersion parameters estimation.
`DGbeta`	Cook distance of location parameters estimation.
`DGphi`	Cook distance of dispersion parameters estimation.
`Cic`	Normal curvature for case-weight perturbation.
`Cih`	Normal curvature for scale perturbation.
`Lmaxr`	Local influence on response (additive perturbation in responce).
`Lmaxc`	Local influence on coefficients (additive perturbation in predictors).

References

Galea, M., Paula, G. A., and Cysneiros, F. J. A. (2005). On diagnostics in symmetrical nonlinear models. Statistics & Probability Letters, 73(4), 459-467. https://doi.org/10.1016/j.spl.2005.04.033

See Also

`elliptical`

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
```

```
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5),
data=luz)
elliptical.diag(elliptical.fitt)
```

`elliptical.diag.plots` *Diagnostic Plots for Elliptical Regression Models*

Description

This function generate diagnostic measures plots for the fitted elliptical regression models.

Usage

```
elliptical.diag.plots(object, ellipticaldiag = NULL, which,
  subset = NULL, iden = FALSE, labels = NULL, ret = FALSE, ...)
```

Arguments

`object`	an object with the result of the fitted elliptical regression model.
`ellipticaldiag`	objects containing the diagnostic measures. If is `NULL` (by default) is obtained from object.
`which`	an optional numeric value with the number of plot returned.
`subset`	an optional numeric vector specifying a subset of observations to be used in the fitting process.
`iden`	a logical value used to identify observations. If `TRUE` the observations are identified in the graphic window.
`labels`	a optinal string vector specifying a labels plots.
`ret`	a logical value to return the diagnostic measures computing. If `FALSE` (by default) not return the diagnostic measures.
`...`	graphics parameters to be passed to the plotting routines.

Value

Return an interactive menu with eleven options to make plots. This menu contains the follows graphics : 1: plot: All. 2: plot: Response residual against fitted values. 3: plot: Response residual against index. 4: plot: Standardized residual against fitted values. 5: plot: Standardized residual against index. 6: plot: QQ-plot of response residuals. 7: plot: QQ-plot of Standardized residuals. 8: plot: Generalized Leverage. 9: plot: Local influence on the response against index. 10: plot: Local influence on the scale against index. 11: plot: Local influence for case-weight against index. If `which` is provided return an unique graphic selected. If `ret` is `TRUE` returns a list of diagnostic arrays (see `elliptical.diag` for more details).

References

Galea, M., Paula, G. A., and Cysneiros, F. J. A. (2005). On diagnostics in symmetrical nonlinear models. Statistics & Probability Letters, 73(4), 459-467. https://doi.org/10.1016/j.spl.2005.04.033

See Also

elliptical, elliptical.diag

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5),
data=luz)
elliptical.diag.plots(elliptical.fitt, which=3)
```

---

envelope *Simulated Envelope of Residuals*

Description

This function produces quantile-quantile residuals plot with simulated envelope for the specified error distribution in elliptical regression models.

Usage

```
envelope(object, B = 100, arg = arg, ...)
```

Arguments

object	an object with the result of the fitted elliptical regression model.
B	number of monte carlo simulations.
arg	a numerical or vector representing the distribution parameters used.
...	arguments to be used to form the default control argument if it is not supplied directly.

References

Galea, M., Paula, G. A., and Cysneiros, F. J. A. (2005). On diagnostics in symmetrical nonlinear models. Statistics & Probability Letters, 73(4), 459-467. https://doi.org/10.1016/j.spl.2005.04.033

See Also

glm, elliptical, family.elliptical

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5),
data=luz)
envelope(elliptical.fitt, B=100, arg=5)
```

---

family.elliptical *Family Objects for Elliptical Models*

Description

Family object provide an specify the details of the model used by functions such as elliptical and gwer. See the documentation for elliptical or gwer for more details.

Usage

```
## S3 method for class 'elliptical'
family(object, ...)

Normal()

Cauchy()

LogisI()

LogisII()

Student(df = stop("no df argument"))

Powerexp(k = stop("no k argument"))

Glogis(parma = stop("no alpha=alpha(m) or m argument"))

Gstudent(parm = stop("no s or r argument"))

Cnormal(parmt = stop("no epsi or sigma argument"))
```

Arguments

object	an object with the result of the fitted elliptical regression model.
...	arguments to be used to form the default control argument if it is not supplied directly.
df	degrees of freedom.
k	shape parameter.
parma	parameter vector (alpha, m).
parm	parameter vector (s, r) for this distribuition.
parmt	parameters vector (epsi, sigma).

Value

An object of class "family" specifying a list with the follows elements:

family	character: the family name.
g0, g1, g2, g3, g4, g5	derived fuctions associated with the distribution family defined.
df	degree of freedom for t-student distribution.
s, r	shape parameters for generalized t-student distribution.
alpha	shape parameter for contaminated normal and generalized logistic distributions.
mp	shape parameter for generalized logistic distribution.
epsi,sigmap	dispersion parameters for contaminated normal distribution.
k	shape parameter for power exponential distribution.

References

Fang, K. T., Kotz, S. and NG, K. W. (1990, ISBN:9781315897943). Symmetric Multivariate and Related Distributions. London: Chapman and Hall.

See Also

elliptical, gwer

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Normal()
,data=luz)
family(elliptical.fitt)
```

gwer *Geographically Weighted Elliptical Regression*

Description

The function fit geographically weighted elliptical regression model to explore the non-stationarity for a certain bandwidth and weighting function.

Usage

```
gwer(formula, data = sys.parent(), coords, bandwidth,
  gweight = gwr.Gauss, adapt = NULL, hatmatrix = FALSE, fit.points,
  family = Normal, longlat = NULL, weights, dispersion = NULL,
  subset, na.action = "na.fail", method = "gwer.fit",
  control = glm.control(epsilon = 1e-04, maxit = 100, trace = F),
  model = FALSE, x = FALSE, y = TRUE, contrasts = NULL, offset,
  type = "pearson", spdisp = FALSE, parplot = FALSE, ...)
```

Arguments

formula	regression model formula as in glm.
data	model data frame, or may be a SpatialPointsDataFrame or SpatialPolygonsDataFrame as defined in package **sp**.
coords	matrix of coordinates of points representing the spatial positions of the observations.
bandwidth	value of the selected bandwidth used in the weighting function (see gwer.sel for bandwidth optimization).
gweight	geographical weighting function, at present gwr.Gauss() is default.
adapt	defines the type of bandwidth used. either NULL (default) or a proportion between 0 and 1 of observations to include in weighting scheme (k-nearest neighbours).
hatmatrix	if TRUE, return the hatmatrix as a component of the result, ignored if fit.points given
fit.points	an object containing the coordinates of fit points, often an object from package **sp**. If missing, the coordinates given through the data argument object, or the coords argument are used.
family	a description of the error distribution to be used in the model (see elliptical.family for details of family functions).
longlat	TRUE if point coordinates are longitude-latitude decimal degrees, in which case distances are measured in kilometers. If x is a SpatialPoints object, the value is taken from the object itself.
weights	an optional numeric vector of weights to be used in the fitting process.
dispersion	an optional fixed value for dispersion parameter.

subset	an optional numeric vector specifying a subset of observations to be used in the fitting process.
na.action	a function which indicates what should happen when the data contain NAs (see glm).
method	the method to be used in fitting local models. The default method "gwer.fit" uses Fisher's scoring method. The alternative "model.frame" returns the model frame and does no fitting.
control	a list of parameters for controlling the fitting process. For elliptical this is passed by glm.control.
model	a logical value indicating whether model frame should be included as a component of the return.
x	a logical value indicating whether the response vector used in the fitting process should be returned as components of the return.
y	a logical value indicating whether model matrix used in the fitting process should be returned as components of the return.
contrasts	an optional list. See the contrasts.arg of model.matrix.default.
offset	this can be used to specify an a priori known component to be included in the linear predictor during fitting as in glm.
type	a character string that indicates the type of residuals should consider as return.
spdisp	if TRUE dispersion parameter varies geographically.
parplot	if TRUE the parameters boxplots are plotted.
...	arguments to be used to form the default control argument if it is not supplied directly.

Value

returns an object of class "gwer", a list with follow components:

SDF	a SpatialPointsDataFrame (may be gridded) or SpatialPolygonsDataFrame object (see package **sp**) with fit.points, weights, GWR coefficient estimates, dispersion and the residuals of type in its data slot.
coef	the matrices of coefficients, standard errors and significance values for parameters hypothesis test.
dispersion	either the supplied argument or the estimated dispersion with standard error.
hat	hat matrix of the geographically weighted elliptical model.
lm	elliptical global regression on the same model formula.
results	a list of results values for fitted geographically weighted elliptical model.
bandwidth	the bandwidth used in geographical weighting function.
fitted	the fitted mean values of the geographically weighted elliptical model.
hatmatrix	a logical value indicating if hatmatrix was considered
gweights	a matrix with the geographical weighting for all local elliptical models.
family	the family object used.

flm	a matrix with the fitted values for all local elliptical models.
adapt	the adapt object used.
gweight	the gweights object used.
spdisp	the spdisp object used.
this.call	the function call used.
fp.given	the fp.given object used.
longlat	the longlat object used.
type	the type residuals for the object used.

References

Brunsdon, C., Fotheringham, A. S. and Charlton, M. E. (1996). Geographically weighted regression: a method for exploring spatial nonstationarity. Geographical analysis, 28(4), 281-298. https://doi.org/10.1111/j.1538-4632.1996.tb00936.x

Cysneiros, F. J. A., Paula, G. A., and Galea, M. (2007). Heteroscedastic symmetrical linear models. Statistics & probability letters, 77(11), 1084-1090. https://doi.org/10.1016/j.spl.2007.01.012

Fang, K. T., Kotz, S. and NG, K. W. (1990, ISBN:9781315897943). Symmetric Multivariate and Related Distributions. London: Chapman and Hall.

See Also

gwer.sel, elliptical, family.elliptical

Examples

```
data(columbus, package="spData")
fit.lm <- lm(CRIME ~ INC, data=columbus)
summary(fit.lm)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Normal(),
                coords=cbind(columbus$X, columbus$Y), method = 'aic')
gwer.fit <- gwer(CRIME ~ INC, family = Normal(), bandwidth = gwer.bw, hatmatrix = TRUE,
                spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
print(gwer.fit)

data(columbus, package="spData")
fit.elliptical <- elliptical(CRIME ~ INC, family = Student(df=4), data=columbus)
summary(fit.elliptical)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Student(df=4),
                coords=cbind(columbus$X, columbus$Y), method = 'aic')
gwer.fitt <- gwer(CRIME ~ INC, family = Student(df=4), bandwidth = gwer.bw, hatmatrix = TRUE,
                spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
print(gwer.fitt)
```

gwer.diag *Diagnostic for Geographically Weighted Elliptical Regression Models*

Description

This function obtains the values of differents residuals types and calculates the diagnostic measures for the fitted geographically weighted elliptical regression model.

Usage

```
gwer.diag(object, ...)
```

Arguments

object	an object with the result of the fitted geographically weighted elliptical regression model.
...	arguments to be used to form the default control argument if it is not supplied directly.

Value

Returns a list of diagnostic arrays:

ro	Ordinal residuals.
rr	Response residuals.
rp	Pearson residuals.
rs	Studentized residuals.
rd	Deviance residuals.
dispersion	Coefficient of dispersion.
H	The hat matrix.
h	Main diagonal of the hat matrix.
GL	Generalized leverage.
GLbeta	Generalized leverage of location parameters estimation.
GLphi	Generalized leverage of dispersion parameters estimation.
DGbeta	Cook distance of location parameters estimation.
DGphi	Cook distance of dispersion parameters estimation.
Cic	Normal curvature for case-weight perturbation.
Cih	Normal curvature for scale perturbation.
Lmaxr	Local influence on response (additive perturbation in responce).
Lmaxc	Local influence on coefficients (additive perturbation in predictors).

References

Galea, M., Paula, G. A., and Cysneiros, F. J. A. (2005). On diagnostics in symmetrical nonlinear models. Statistics & Probability Letters, 73(4), 459-467. https://doi.org/10.1016/j.spl.2005.04.033

See Also

elliptical

Examples

```
data(columbus, package="spData")
fit.lm <- lm(CRIME ~ INC, data=columbus)
summary(fit.lm)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Normal(),
                coords=cbind(columbus$X, columbus$Y))
gwer.fitn <- gwer(CRIME ~ INC, family = Normal(), bandwidth = gwer.bw, hatmatrix = TRUE,
                spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
gwer.diag(gwer.fitn)

data(columbus, package="spData")
fit.elliptical <- elliptical(CRIME ~ INC, family = Student(df=3), data=columbus)
summary(fit.elliptical)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Student(df=3),
                coords=cbind(columbus$X, columbus$Y), method = 'aic')
gwer.fitt <- gwer(CRIME ~ INC, family = Student(df=3), bandwidth = gwer.bw,
                spdisp = TRUE, hatmatrix = TRUE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
gwer.diag(gwer.fitt)
```

---

gwer.diag.plots *Diagnostic Plots for Geographically Weighted Elliptical Regression Models*

Description

This function generate diagnostic measures plots for the fitted geographically weighted elliptical regression models.

Usage

```
gwer.diag.plots(object, gwerdiag = NULL, which, subset = NULL,
  iden = F, labels = NULL, ret = F, ...)
```

Arguments

object	an object with the result of the fitted geographically weighted elliptical regression models.
gwerdiag	objects containing the diagnostic measures. If is NULL (by default) is obtained from object.
which	an optional numeric value with the number of plot returned.
subset	an optional numeric vector specifying a subset of observations to be used in the fitting process.
iden	a logical value used to identify observations. If TRUE the observations are identified in the graphic window.
labels	a optinal string vector specifying a labels plots.
ret	a logical value to return the diagnostic measures computing. If FALSE (by default) not return the diagnostic measures.
...	graphics parameters to be passed to the plotting routines.

Value

Return an interactive menu with eleven options to make plots. This menu contains the follows graphics : 1: plot: All. 2: plot: Response residual against fitted values. 3: plot: Moran dispersion of the response residual. 4: plot: Standardized residual against fitted values. 5: plot: Moran dispersion of the standardized residual. 6: plot: QQ-plot of response residuals. 7: plot: QQ-plot of Standardized residuals. 8: plot: Generalized Leverage. 9: plot: Local influence on the response against index. 10: plot: Local influence on the scale against index. 11: plot: Local influence for case-weight against index. If which is provided return an unique graphic selected. If ret is TRUE returns a list of diagnostic arrays (see gwer.diag for more details).

References

Galea, M., Paula, G. A., and Cysneiros, F. J. A. (2005). On diagnostics in symmetrical nonlinear models. Statistics & Probability Letters, 73(4), 459-467. https://doi.org/10.1016/j.spl.2005.04.033

See Also

elliptical, elliptical.diag

Examples

```
data(columbus, package="spData")
fit.lm <- lm(CRIME ~ INC, data=columbus)
summary(fit.lm)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Normal(),
                coords=cbind(columbus$X, columbus$Y))
gwer.fitn <- gwer(CRIME ~ INC, family = Normal(), bandwidth = gwer.bw, hatmatrix = TRUE,
                spdisp = TRUE, parplot = FALSE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
gwer.diag.plots(gwer.fitn, which=3)
```

```
data(columbus, package="spData")
fit.elliptical <- elliptical(CRIME ~ INC, family = Student(df=4), data=columbus)
summary(fit.elliptical)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Student(df=4),
                coords=cbind(columbus$X, columbus$Y), method = 'aic')
gwer.fitt <- gwer(CRIME ~ INC, family = Student(df=4), bandwidth = gwer.bw, hatmatrix = TRUE,
                spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
gwer.diag.plots(gwer.fitt, which=3)
```

`gwer.sel` *Optimization of Bandwidth for Geographically Weighted Elliptical Regression Model*

Description

The function compute the optimal bandwidth for a given geographically weighted elliptical regression using three differents methods: cross-validation, AIC and spatial validation. This optimal bandwidth optimzing the selected function.

Usage

```
gwer.sel(formula, data = list(), coords, adapt = FALSE,
  gweight = gwr.Gauss, weights, method = "cv", verbose = TRUE,
  longlat = NULL, family = Normal(), RMSE = FALSE,
  tol = .Machine$double.eps^0.25, show.error.messages = FALSE,
  maxit = 100)
```

Arguments

`formula`	regression model formula as in `glm`.
`data`	model data frame, or may be a SpatialPointsDataFrame or SpatialPolygonsDataFrame as defined in package **sp**.
`coords`	matrix of coordinates of points representing the spatial positions of the observations.
`adapt`	defines the type of bandwidth used. Either TRUE: find the proportion between 0 and 1 of observations to include in weighting scheme (k-nearest neighbours) or FALSE: find global bandwidth.
`gweight`	geographical weighting function, at present `gwr.Gauss()` default.
`weights`	an optional numeric vector of weights to be used in the fitting process, beware of scaling issues. Only used with the cross-validation method, probably unsafe.
`method`	type of the method used to the compute of residuals. Is `cv` for drop-1 cross-validation (default), `aic` for AIC optimisation (depends on assumptions about AIC degrees of freedom) or `sv` for spatial validation.

verbose	if TRUE (default) reports the progress of search for bandwidth.
longlat	TRUE if point coordinates are longitude-latitude decimal degrees, in which case distances are measured in kilometers; if x is a SpatialPoints object, the value is taken from the object itself.
family	a description of the error distribution to be used in the model (see family.elliptical for more details of family functions).
RMSE	default FALSE to correspond with CV scores in newer references (sum of squared CV errors), if TRUE the previous behaviour of scoring by LOO CV RMSE.
tol	the desired accuracy to be passed to optimize.
show.error.messages	default FALSE. may be set to TRUE to see error messages if gwer.sel returns without a value.
maxit	maximum number of iterations in model fit

Value

returns the bandwidth optimization value.

References

Brunsdon, C., Fotheringham, A. S. and Charlton, M. E. (1996). Geographically weighted regression: a method for exploring spatial nonstationarity. Geographical analysis, 28(4), 281-298. https://doi.org/10.1111/j.1538-4632.1996.tb00936.x

Cysneiros, F. J. A., Paula, G. A., and Galea, M. (2007). Heteroscedastic symmetrical linear models. Statistics & probability letters, 77(11), 1084-1090. https://doi.org/10.1016/j.spl.2007.01.012

Fang, K. T., Kotz, S. and NG, K. W. (1990, ISBN:9781315897943). Symmetric Multivariate and Related Distributions. London: Chapman and Hall.

See Also

gwer, elliptical, family.elliptical

Examples

```
data(columbus, package="spData")
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Normal(),
                coords=cbind(columbus$X, columbus$Y))

data(columbus, package="spData")
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Student(df=4),
                coords=cbind(columbus$X, columbus$Y), method = "aic")
```

luzdat *Brightness of Snacks Dataset*

Description

This dataset its a part of a study development by the nutritional department of USP (S\~ao Paulo University) such that is compared five new type composition of the snack with low saturated fat and fatty acids.

Usage

```
data(luzdat)
```

Format

The "data" slot is a data frame with 150 observations on the following 4 variables.

y the brightness of the product on a scale of 0 to 100 (the higher the value the product lighter).

x1 its the type compositions for the news snacks.

x2 its the time (in weeks) when was measurements the brightness of the product.

rot a characters vector that indicate the group-week-measurement for each snack.

References

Paula, G. A., de Moura, A. S. and Yamaguchi, A. M. (2004). Relat\'orio de an\'alise estat\'istica sobre o projeto: estabilidade sensorial de snacks aromatizados com \'oleo de canola e gordura vegetal hidrogenada. RAE-CEA 04105, IME-USP.

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5)
,data=luz)
```

`residuals.elliptical` *Extract Residuals for Elliptical Model Fits*

Description

This function compute differents type of residuals to the fitted elliptical regression model.

Usage

```
## S3 method for class 'elliptical'
residuals(object, type = c("stand", "ordinal",
  "response", "pearson", "desvio"), ...)
```

Arguments

`object`	an object with the result of the fitted elliptical regression model.
`type`	a character string that indicates the type of residuals. If is `stand` will be computed the standar residuals. If is `ordinal` will be computed the ordinal residuals. If is `response` will be computed the response residuals. If is `pearson` will be computed the pearson residuals. If is `desvio` will be computed the desviance residuals. By default is `stand`.
`...`	arguments to be used to form the default control argument if it is not supplied directly.

Value

Residuals of the specific `type` extracted from the `object`.

References

Galea, M., Paula, G. A., and Cysneiros, F. J. A. (2005). On diagnostics in symmetrical nonlinear models. Statistics & Probability Letters, 73(4), 459-467. https://doi.org/10.1016/j.spl.2005.04.033

See Also

`elliptical`

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5)
,data=luz)
residuals(elliptical.fitt, type = "stand")
```

`residuals.gwer` *Extract Residuals for Geographically Weighted Elliptical Regression Model Fits*

Description

This function compute differents type of residuals to the fittedgeographically weighted elliptical regression model.

Usage

```
## S3 method for class 'gwer'
residuals(object, type = c("stand", "ordinal", "response",
  "pearson", "desvio"), ...)
```

Arguments

`object`	an object with the result of the fitted geographically weighted elliptical regression model.
`type`	a character string that indicates the type of residuals. If is `stand` will be computed the standar residuals. If is `ordinal` will be computed the ordinal residuals. If is `response` will be computed the response residuals. If is `pearson` will be computed the pearson residuals. If is `desvio` will be computed the desviance residuals. By default is `stand`.
`...`	arguments to be used to form the default control argument if it is not supplied directly.

Value

Residuals of the specific `type` extracted from the `object`.

References

Brunsdon, C., Fotheringham, A. S. and Charlton, M. E. (1996). Geographically weighted regression: a method for exploring spatial nonstationarity. Geographical analysis, 28(4), 281-298. https://doi.org/10.1111/j.1538-4632.1996.tb00936.x

Galea, M., Paula, G. A., and Cysneiros, F. J. A. (2005). On diagnostics in symmetrical nonlinear models. Statistics & Probability Letters, 73(4), 459-467. https://doi.org/10.1016/j.spl.2005.04.033

See Also

`residuals`, `gwer`, `family.elliptical`

Examples

```
data(columbus, package="spData")
fit.lm <- lm(CRIME ~ INC, data=columbus)
summary(fit.lm)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Normal(),
                coords=cbind(columbus$X, columbus$Y))
fit.gwer <- gwer(CRIME ~ INC, family = Normal(), bandwidth = gwer.bw,
                spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
residuals(fit.gwer, type = "stand")

data(columbus, package="spData")
fit.elliptical <- elliptical(CRIME ~ INC, family = Student(df=4), data=columbus)
summary(fit.elliptical)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Student(df=4),
                coords=cbind(columbus$X, columbus$Y), method = 'aic')
gwer.fitt <- gwer(CRIME ~ INC, family = Student(df=4), bandwidth = gwer.bw, hatmatrix = TRUE,
                spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                coords=cbind(columbus$X, columbus$Y))
residuals(gwer.fitt)
```

`summary.elliptical` *Summarizing Elliptical Model Fits.*

Description

This function produce result summary of the result of the fitted elliptical regression model.

Usage

```
## S3 method for class 'elliptical'
summary(object, correlation = TRUE, ...)
```

Arguments

`object`	an object with the result of the fitted elliptical regression model.
`correlation`	a logical value to return the correlation for the estimated parameters. If `FALSE` (by default) not return the correlation matrix.
`...`	arguments to be used to form the default control argument if it is not supplied directly.

Value

returns an object of class "summary.elliptical", a list with follow components:

`coefficients`	the matrix of coefficients, standard errors and significance values for parameters hypothesis test.

dispersion	either the supplied argument or the estimated dispersion with standard error.
residuals	the residuals from object.
cov.unscaled	the unscaled (dispersion = 1) estimated covariance matrix of the estimated coefficients.
corrrelation	the matrix of correlation for the estimated parameters.
family	family from object.
loglik	the likelihood logarithm value from object.
terms	the terms object used.
df	degrees of fredom from object.
inter	number of iterations of optimization process.
nas	a logical vector indicating if there is na in estimation of coefficients.
call	the matched call from object.
scale	values of the 4d_g for the specified distribution from object.
scaledispersion	values of the 4f_g for the specified distribution from object.

References

Cysneiros, F. J. A., Paula, G. A., and Galea, M. (2007). Heteroscedastic symmetrical linear models. Statistics & probability letters, 77(11), 1084-1090. https://doi.org/10.1016/j.spl.2007.01.012

See Also

glm, elliptical, family.elliptical

Examples

```
data(luzdat)
y <- luzdat$y
x1 <- luzdat$x1 ; x1 <- factor(x1) ; x1 <- C(x1,treatment)
x2 <- luzdat$x2
x3 <- (luzdat$x2)^2
luz <- data.frame(y,x1,x2,x3)
elliptical.fitt <- elliptical(y ~ x1+x2+x3, family = Student(df=5)
,data=luz)
summary(elliptical.fitt)
```

summary.gwer *Summarizing Geographically Weighted Elliptical Regression Model Fits.*

Description

This function produce result summary of the result of the fitted geographically weighted elliptical regression model.

Usage

```
## S3 method for class 'gwer'
summary(object, ...)
```

Arguments

object	an object with the result of the fitted geographically weighted elliptical regression model.
...	arguments to be used to form the default control argument if it is not supplied directly.

Value

returns an object of class "summary.gwer", a list with follow components:

coefficients	the matrix of summarizing coefficients, standard errors and significance values for parameters hypothesis test.
dispersion	either the supplied argument or the estimated dispersion with standard error.
residuals	the residuals from object.
family	family from object.
results	a list of results values for fitted geographically weighted elliptical model.
spdisp	a logical value indicating whether the dispersion varies geographically from object.
df	degrees of fredom from object.
terms	the terms object used.
inter	number of iterations of optimization process.
nas	a logical vector indicating if there is na in estimation of coefficients.
type	a character string indicating the type of residuals was obtained from object
hatmatrix	a logical value indicating if hatmatrix was obtained from object
call	the matched call from object.
scale	values of the 4d_g for the specified distribution from object.
scaledispersion	values of the 4f_g for the specified distribution from object.
scalevariance	values of the scale variance for the specified distribution from object.

References

Brunsdon, C., Fotheringham, A. S. and Charlton, M. E. (1996). Geographically weighted regression: a method for exploring spatial nonstationarity. Geographical analysis, 28(4), 281-298. https://doi.org/10.1111/j.1538-4632.1996.tb00936.x

Cysneiros, F. J. A., Paula, G. A., and Galea, M. (2007). Heteroscedastic symmetrical linear models. Statistics & probability letters, 77(11), 1084-1090. https://doi.org/10.1016/j.spl.2007.01.012

See Also

gwer, gwer.sel, family.elliptical

Examples

```
data(columbus, package="spData")
fit.lm <- lm(CRIME ~ INC, data=columbus)
summary(fit.lm)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Normal(),
                    coords=cbind(columbus$X, columbus$Y))
fit.gwer <- gwer(CRIME ~ INC, family = Normal(), bandwidth = gwer.bw, hatmatrix = TRUE,
                    spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                    coords=cbind(columbus$X, columbus$Y))
summary(fit.gwer)

data(columbus, package="spData")
fit.elliptical <- elliptical(CRIME ~ INC, family = Student(df=4), data=columbus)
summary(fit.elliptical)
gwer.bw <- gwer.sel(CRIME ~ INC, data=columbus, family = Student(df=4),
                    coords=cbind(columbus$X, columbus$Y), method = 'aic')
gwer.fitt <- gwer(CRIME ~ INC, family = Student(df=4), bandwidth = gwer.bw, hatmatrix = TRUE,
                    spdisp = TRUE, parplot = TRUE, data=columbus, method = "gwer.fit",
                    coords=cbind(columbus$X, columbus$Y))
summary(gwer.fitt)
```

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