Package 'RXshrink'

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Title Maximum Likelihood Shrinkage via Generalized Ridge or Least
Angle Regression

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Depends R (>= 1.8.0), lars

Description Identify and display TRACEs for a specified shrinkage path and determine
the extent of shrinkage most likely, under normal distribution theory, to produce an
optimal reduction in MSE Risk in estimates of regression (beta) coefficients.

License GPL (>= 2)

URL <http://www.r-project.org>, <http://members.iquest.net/~softrx>

NeedsCompilation no

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R topics documented:

RXshrink-package	*Maximum Likelihood Shrinkage via Generalized Ridge or Least Angle Regression*

Description

The functions in this package augment the basic calculations of Generalized Ridge and Least Angle Regression with important visualization tools. Specifically, they display TRACEs of normal-distribution-theory Maximum Likelihood estimates of the key quantities that completely characterize the effects of shrinkage on the MSE Risk of fitted coefficients.

Details

Package:	RXshrink
Type:	Package
Version:	1.0-7
Date:	2011-12-24
License:	GNU GENERAL PUBLIC LICENSE, Version 2, June 1991

RXridge() calculates and displays TRACEs for the **Q**-shaped shrinkage path, including the **M**-extent of shrinkage along that path, that are most likely under normal distribution theory to yield optimal reducions in MSE Risk.

When regression parameters have specified, KNOWN numerical values, RXtrisk() calculates and displays the corresponding True MSE Risk profiles and RXtsimu() first simulates Y-outcome data then calculates true Squared Error Losss associated with **Q**-shape shrinkage.

RXlarlso() calls the Efron/Hastie lars() R-function to perform Least Angle Regression then augments these calculations with Maximum Likelihood TRACE displays like those of RXridge().

RXuclars() applies Least Angle Regression to the uncorrelated components of a possibly ill-conditioned set of X-variables using a closed-form expression for the lars/lasso shrinkage delta factors that exits in this special case.

Author(s)

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References

Efron B, Hastie T, Johnstone I, Tibshirani R. (2004) Least angle regression. *Ann. Statis.* **32**, 407-499.

Goldstein M, Smith AFM. (1974) Ridge-type estimators for regression analysis. *J. Roy. Stat. Soc. B* **36**, 284-291. (2-parameter shrinkage family.)

Obenchain RL. (2005) *Shrinkage Regression: ridge, BLUP, Bayes, spline and Stein.* Electronic book-in-progress (200+ pages.) http://members.iquest.net/~softrx/.

Obenchain RL. (2011) *shrink.PDF* Vignette-like documentation stored in the R library/RXshrink/doc folder. 23 pages.

Examples

```
demo(longley2)
```

---

haldport   *Portland Cement benchmark of Hald(1952)*

Description

Heat evolved during setting of 13 cement mixtures of four basic ingredients. Each ingredient percentage appears to be rounded down to a full integer. The sum of the four mixture percentages varies from a maximum of 99% to a minimum of 95%. If all four regressor X-variables always summed to 100%, the centered X-matrix would then be of rank only 3. Thus, the regression of heat on four X-percentages is ill-conditioned, with an approximate rank deficiency of MCAL = 1.

Usage

```
data(haldport)
```

Format

A data frame with 13 observations on the following 5 variables.

p3ca Integer percentage of $3CaO.Al_2O_3$ in the mixture.

p3cs Integer percentage of $3CaO.SiO_2$ in the mixture.

p4caf Integer percentage of $4CaO.Al_2O_3.Fe_2O_3$ in the mixture.

p2cs Integer percentage of $2CaO.SiO_2$ in the mixture.

heat Heat (cals/gm) evolved in setting, recorded to nearest tenth.

Details

The (RXshrink) haldport data are identical to the (MASS) cement data except for variable names.

Source

Woods H, Steinour HH, Starke HR. "Effect of composition of Portland cement on heat evolved during hardening. Industrial Engineering and Chemistry 1932; 24: 1207-1214.

References

Hald A. Statistical Theory with Engineering Applications. 1952 (page 647.) New York; Wiley.

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longley2   *Art Hoerl's update of the infamous Longley(1967) benchmark dataset*

Description

Data from the "Employment and Training Report of the President, 1976" compiled by Art Hoerl, University of Delaware. Some slightly different numerical values than those used by Longley(1967) ...plus the added years of 1963-1975. Longley(1967) used only data from the 16 years of 1947 through 1962.

Usage

```
data(longley2)
```

Format

A data frame of 7 variables collected for 29 consecutive years; no NAs.

GNP.deflator GNP price deflation index.

Unemployed Unemployment percentage.

Armed.Forces Size of the Armed Forces.

Population Total U.S. Population.

Year 1947 to 1975.

Employed employment.

GNP Gross National Product.

References

Longley JW. An appraisal of least-squares programs from the point of view of the user. J. Amer. Statist. Assoc. 1967; 62: 819-841.

---

mpg   *Hocking(1976) Miles Per Gallon benchmark dataset*

Description

Performance data on 32 autos from Motor Trends magazine.

Usage

```
data(mpg)
```

Format

A data frame of 11 variables collected for 32 automobiles; no NAs.

cylnds number of cylinders.

cubins cubic inches of engine displacement.

hpower engine horsepower.

weight total auto weight in pounds.

mpg miles per gallon.

shape engine shape (1=Straight, 0=V).

transm transmission type.

speeds number of forward speeds.

carbs number of carburetors.

fratio final drive rtaio.

qmilt quarter mile time.

References

Hocking RA. "The Analysis and Selection of Variables in Regression." Biometrics 1976; 32: 1-51.

---

plot.RXlarlso   *Plot method for RXlarlso objects*

Description

Plot trace displays for RXlarlso regression coefficients. The default is to display all five traces on one page with no legends.

Usage

```
   ## S3 method for class 'RXlarlso'
plot(x, trace = "all", trkey = FALSE, ...)
```

Arguments

x	Output list object of class RXlarlso.
trace	One of seven possible options: "all" to display 5 traces in one graph, "seq" to display 5 full-sized traces in sequence in response to user prompts, "coef" to display only the estimated beta coefficient trace, "rmse" to display only the estimated relative MSE risk trace, "exev" to display only the estimated excess MSE eigenvalue (OLS minus larlso), "infd" to display only the estimated inferior direction cosine trace, or "spat" to display only the delta-factor pattern trace.
trkey	If TRUE, display a crude legend at the bottom of each trace plot.
...	Optional argument(s) passed on to plot().

Value

NULL

Author(s)

Bob Obenchain <wizbob@att.net>

Examples

```
data(longley2)
form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
rxlobj <- RXlarlso(form, data=longley2)
plot(rxlobj)
```

| plot.RXridge | *Plot method for RXridge objects* |

Description

Plot trace displays for RXridge shrinkage regression coefficients. The default is to display all five traces on one page with no legends.

Usage

```
   ## S3 method for class 'RXridge'
plot(x, trace = "all", trkey = FALSE, ... )
```

Arguments

x	Output list object of class RXridge.
trace	One of seven possible options: "all" to display 5 traces in one graph, "seq" to display 5 full-sized traces in sequence in response to user prompts, "coef" to display only the estimated beta coefficient trace, "rmse" to display only the estimated relative MSE risk trace, "exev" to display only the estimated excess MSE eigenvalue (OLS minus larlso), "infd" to display only the estimated inferior direction cosine trace, or "spat" to display only the delta-factor pattern trace.
trkey	If TRUE, display a crude legend at the bottom of each trace plot.
...	Optional argument(s) passed on to plot().

Value

NULL

Author(s)

Bob Obenchain <wizbob@att.net>

Examples

```
data(longley2)
form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
rxrobj <- RXridge(form, data=longley2)
plot(rxrobj)
```

---

plot.RXtrisk   *Plot method for RXtrisk objects*

Description

Plot trace displays for RXtrisk true regression coefficients. The default is to display all five traces on one page with no legends.

Usage

```
   ## S3 method for class 'RXtrisk'
plot(x, trace = "all", trkey = FALSE, ... )
```

Arguments

x	Output list object of class RXtrisk.
trace	One of seven possible options: "all" to display 5 traces in one graph, "seq" to display 5 full-sized traces in sequence in response to user prompts, "coef" to display only the estimated beta coefficient trace, "rmse" to display only the estimated relative MSE risk trace, "exev" to display only the estimated excess MSE eigenvalue (OLS minus larlso), "infd" to display only the estimated inferior direction cosine trace, or "spat" to display only the shrinkage (delta) factor pattern trace.
trkey	If TRUE, display a crude legend at the bottom of each trace plot.
...	Optional argument(s) passed on to plot().

Value

NULL

Author(s)

Bob Obenchain <wizbob@att.net>

Examples

```
data(longley2)
form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
# set true regression parameter values not unlike their OLS estimates from RXridge().
trugam <- matrix(c(.5,-.1,.2,.2,.2,-.2),6,1)
trusig <- 0.04
rxtobj <- RXtrisk(form, data=longley2, trugam, trusig, Q=-1.5)
plot(rxtobj)
```

| plot.RXtsimu | *Plot method for RXtsimu objects* |

Description

Plot trace displays for RXtsimu simulated regression coefficients. The default is to display all three traces on one page with no legends.

Usage

```
   ## S3 method for class 'RXtsimu'
plot(x, trace = "all", trkey = FALSE, ... )
```

Arguments

x	Output list object of class RXtsimu.
trace	One of five possible options: "all" to display 3 traces in one graph, "seq" to display 3 full-sized traces in sequence in response to user prompts, "coef" to display only the estimated shrunken beta coefficient trace, "rsel" to display only the relative squared error loss trace, or "spat" to display only the shrinkage (delta) factor pattern.
trkey	If TRUE, display a crude legend at the bottom of each trace plot.
...	Optional argument(s) passed on to plot().

Value

NULL

Author(s)

Bob Obenchain <wizbob@att.net>

Examples

```
    data(longley2)
    form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
    # set true regression parameter values not unlike their OLS estimates from RXridge().
    trugam <- matrix(c(.5,-.1,.2,.2,.2,-.2),6,1)
    trusig <- 0.04
    rxsobj <- RXtsimu(form, data=longley2, trugam, trusig, Q=-1.5)
    plot(rxsobj)
```

---

plot.RXuclars *Plot method for RXuclars objects*

Description

Plot trace displays for RXuclars regression coefficients. The default is to display all five traces on one page with no legends.

Usage

```
   ## S3 method for class 'RXuclars'
plot(x, trace = "all", trkey = FALSE, ...)
```

Arguments

x	Output list object of class RXuclars.
trace	One of seven possible options: "all" to display 5 traces in one graph, "seq" to display 5 full-sized traces in sequence in response to user prompts, "coef" to display only the estimated shrunken beta coefficient trace, "rmse" to display only the estimated relative MSE risk trace, "exev" to display only the estimated excess MSE eigenvalue (OLS minus ridge) trace, "infd" to display only the estimated inferior direction cosine trace, or "spat" to display only the shrinkage (delta) factor pattern trace.
trkey	If TRUE, display a crude legend at the bottom of each trace plot.
...	Optional argument(s) passed on to plot().

Value

NULL

Author(s)

Bob Obenchain <wizbob@att.net>

Examples

```
   data(longley2)
   form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
   rxuobj <- RXuclars(form, data=longley2)
   plot(rxuobj)
```

RXlarlso   *Maximum Likelihood Estimation of Effects in Least Angle Regression*

Description

Identify whether least angle regression estimates are generalized ridge shrinkage estimates and generate TRACE displays for estimates that do correspond to ridge shrinkage factors between 0.00 and 0.99.

Usage

```
RXlarlso(form, data, rscale = 1, type = "lar", trace = FALSE,
         eps = .Machine$double.eps, omdmin = 9.9e-13, ...)
```

Arguments

form	A regression formula [y~x1+x2+...] suitable for use with lm().
data	Data frame containing observations on all variables in the formula.
rscale	One of three possible choices (0, 1 or 2) for rescaling of variables as they are being "centered" to remove non-essential ill-conditioning: 0 implies no rescaling; 1 implies divide each variable by its standard error; 2 implies rescale as in option 1 but re-express answers as in option 0.
type	One of "lasso", "lar" or "forward.stagewise" for function lars(). Names can be abbreviated to any unique substring. Default in RXlarlso() is "lar".
trace	If TRUE, lars() function prints out its progress.
eps	The effective zero for lars().
omdmin	Strictly positive minimum allowed value for one-minus-delta (default = 9.9e-013.)
...	Optional argument(s) passed on to the lars() function from the lars R-package.

Details

RXlarlso() calls the Efron/Hastie lars() function to perform Least Angle Regression on X-variables that have been centered and possibly rescaled but which may be (highly) correlated. Maximum likelihood TRACE displays paralleling those of RXridge are also computed and (optionally) plotted.

Value

An output list object of class RXlarlso:

form	The regression formula specified as the first argument.
data	Name of the data.frame object specified as the second argument.
p	Number of regression predictor variables.
n	Number of complete observations after removal of all missing values.

r2	Numerical value of R-square goodness-of-fit statistic.
s2	Numerical value of the residual mean square estimate of error.
prinstat	Listing of principal statistics.
gmat	Orthogonal matrix of direction cosines for regressor principal axes.
lars	An object of class lars.
coef	Matrix of shrinkage-ridge regression coefficient estimates.
risk	Matrix of MSE risk estimates for fitted coefficients.
exev	Matrix of excess MSE eigenvalues (ordinary least squares minus ridge.)
infd	Matrix of direction cosines for the estimated inferior direction, if any.
spat	Matrix of shrinkage pattern multiplicative delta factors.
mlik	Listing of criteria for maximum likelihood selection of M-extent-of-shrinkage.
sext	Listing of summary statistics for all M-extents-of-shrinkage.

Author(s)

Bob Obenchain <wizbob@att.net>

References

Breiman L. (1995) Better subset regression using the non-negative garrote. *Technometrics* **37**, 373-384.

Efron B, Hastie T, Johnstone I, Tibshirani R. (2004) Least angle regression. *Ann. Statis.* **32**, 407-499.

Obenchain RL. (2005) *Shrinkage Regression: ridge, BLUP, Bayes, spline and Stein.* Electronic book-in-progress (200+ pages.) <http://members.iquest.net/~softrx/>

Obenchain RL. (2011) *shrink.PDF* Vignette-like documentation stored in the R library/RXshrink/doc folder. 23 pages.

Tibshirani R. (1996) Regression shrinkage and selection via the lasso. *J. Roy. Stat. Soc. B* **58**, 267-288.

See Also

[RXuclars](#).

Examples

```
data(longley2)
form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
rxlobj <- RXlarlso(form, data=longley2)
rxlobj
names(rxlobj)
plot(rxlobj)
```

RXridge   *Maximum Likelihood Shrinkage in Regression*

Description

Identify and display TRACEs for the **Q**-shaped shrinkage path, including the **M**-extent of shrinkage along that path, that are most likely under normal distribution theory to yield optimal reducions in MSE Risk.

Usage

```
RXridge(form, data, rscale = 1, Q = "qmse", steps = 8, nq = 21,
          qmax = 5, qmin = -5, omdmin = 9.9e-13)
```

Arguments

form	A regression formula [y~x1+x2+...] suitable for use with lm().
data	Data frame containing observations on all variables in the formula.
rscale	One of three possible choices (0, 1 or 2) for rescaling of variables as they are being "centered" to remove non-essential ill-conditioning: 0 implies no rescaling; 1 implies divide each variable by its standard error; 2 implies rescale as in option 1 but re-express answers as in option 0.
Q	Shape parameter that controls the curvature of the shrinkage path through regression-coefficient likelihood space (default = "qmse" implies use the value found most likely to be optimal.) Use Q = 0 to specify Hoerl-Kennard "ordinary" ridge regression.
steps	Number of equally spaced values per unit change along the horizontal M-extent-of-shrinkage axis for estimates to be calculated and displayed in TRACES (default = 8.)
nq	Number of equally spaced values on the lattice of all possible values for shrinkage Q-shape between the "qmin" and "qmax" parameter settings (default = 21.)
qmax	Maximum allowed Q-shape (default = +5.)
qmin	Minimum allowed Q-shape (default = -5.)
omdmin	Strictly positive minimum allowed value for one-minus-delta (default = 9.9e-013.)

Details

Illconditioned and/or nearly multicollinear regression models are unlikely to produce Ordinary Least Squares (OLS) regression coefficient estimates that are very close, numerically, to their unknown true values. Specifically, OLS estimates can then tend to have "wrong" numerical signs and/or unreasable relative magnitudes, while shrunken (generalized ridge) estimates chosen to maximize their likelihood of reducing Mean Squared Error (MSE) Risk (expected loss) can be much more stable and reasonable, numerically. On the other hand, because only OLS estimates are quaranteed to be minimax when risk is matrix valued (truly multivariate), no guarantee of an actual reduction in MSE Risk is necessarily associated with shrinkage.

Value

An output list object of class RXridge:

form	The regression formula specified as the first argument.
data	Name of the data.frame object specified as the second argument.
p	Number of regression predictor variables.
n	Number of complete observations after removal of all missing values.
r2	Numerical value of R-square goodness-of-fit statistic.
s2	Numerical value of the residual mean square estimate of error.
prinstat	Listing of principal statistics.
crlqstat	Listing of criteria for maximum likelihood selection of path Q-shape.
qmse	Numerical value of Q-shape most likely to be optimal.
qp	Numerical value of the Q-shape actually used for shrinkage.
coef	Matrix of shrinkage-ridge regression coefficient estimates.
risk	Matrix of MSE risk estimates for fitted coefficients.
exev	Matrix of excess MSE eigenvalues (ordinary least squares minus ridge.)
infd	Matrix of direction cosines for the estimated inferior direction, if any.
spat	Matrix of shrinkage pattern multiplicative delta factors.
mlik	Listing of criteria for maximum likelihood selection of M-extent-of-shrinkage.
sext	Listing of summary statistics for all M-extents-of-shrinkage.

Author(s)

Bob Obenchain <wizbob@att.net>

References

Goldstein M, Smith AFM. (1974) Ridge-type estimators for regression analysis. *J. Roy. Stat. Soc. B* **36**, 284-291. (2-parameter shrinkage family.)

Burr TL, Fry HA. (2005) Biased Regression: The Case for Cautious Application. *Technometrics* **47**, 284-296.

Obenchain RL. (2005) *Shrinkage Regression: ridge, BLUP, Bayes, spline and Stein.* Electronic book-in-progress (200+ pages.) <http://members.iquest.net/~softrx/>.

Obenchain RL. (2011) *shrink.PDF* Vignette-like documentation stored in the R library/RXshrink/doc folder. 23 pages.

See Also

[RXtrisk](#) and [RXtsimu](#).

Examples

```
data(longley2)
form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
rxrobj <- RXridge(form, data=longley2)
rxrobj
names(rxrobj)
plot(rxrobj)
```

RXtrisk   *True MSE Risk of Shrinkage Resulting from Known Regression Parameters*

Description

By specifying numerical values for regression parameters (uncorrelated components and error sigma) that usually are unknown, these functions can calculate and display True MSE Risk statistics associated with shrinkage along a given **Q**-shaped path.

Usage

```
RXtrisk(form, data, trug, trus, Q = 0, rscale = 1, steps = 8,
                qmax = 5, qmin = -5)
```

Arguments

form	A regression formula [y~x1+x2+...] suitable for use with lm().
data	Data frame containing observations on all variables in the formula.
trug	Column vector of numerical values for the true uncorrelated components of the regression coefficient vector.
trus	Numerical value for the true error standard deviation, Sigma.
Q	Numerical value for the shape parameter controlling shrinkage path curvature. Default shape is Q = 0 for Hoerl-Kennard "ordinary" ridge regression.
rscale	One of three possible choices (0, 1 or 2) for rescaling of variables as they are being "centered" to remove non-essential ill-conditioning: 0 implies no rescaling; 1 implies divide each variable by its standard error; 2 implies rescale as in option 1 but re-express answers as in option 0.
steps	Number of equally spaced values per unit change along the horizontal M-extent-of-shrinkage axis where estimates are calculated and displayed in TRACES (default = 8.)
qmax	Maximum allowed Q-shape (default = +5.)
qmin	Minimum allowed Q-shape (default = -5.)

Details

The RXridge() functions calculate maximum likelihood estimates (corrected, if necessary, so as to have correct range) for typical statistical inference situations where regression parameters are unknowns. In sharp contrast with this usual situation, the RXtrisk() functions show exactly how expected regression coefficients and true Mean Squared Error Risk actually do change with shrinkage when regression parameters take on specified, KNOWN numerical values.

Value

An output list object of class RXtrisk:

form	The regression formula specified as the first argument.
data	Name of the data.frame object specified as the second argument.
trug	Vector of numerical values for the true uncorrelated gamma components.
trus	Numerical value for the true error standard deviation, Sigma.
qp	Numerical value of the Q-shape actually used for shrinkage.
p	Number of regression predictor variables.
n	Number of complete observations after removal of all missing values.
prinstat	Listing of principal statistics.
coef	Matrix of expected shrinkage-ridge regression coefficients.
rmse	Matrix of true MSE risk values for shrunken coefficients.
exev	Matrix of true excess eigenvalues (ordinary least squares minus ridge.)
infd	Matrix of direction cosines for the true inferior direction, if any.
spat	Matrix of shrinkage pattern delta factors.
sext	Listing of summary statistics for all M-extents-of-shrinkage.

Author(s)

Bob Obenchain <wizbob@att.net>

See Also

RXridge and RXtsimu.

Examples

```
data(mpg)
form <- mpg~cylnds+cubins+hpower+weight
rxrobj <- RXridge(form, data=mpg)
# define true parameter values.
trugam <- matrix(c(-.5,-.1,.1,-.6),4,1)
trusig <- 0.4
# create true shrinkage MSE risk scenario.
trumse <- RXtrisk(form, data=mpg, trugam, trusig, Q=-1, steps=4)
plot(trumse)
```

RXtsimu   *True Squared Error LOSS of Shrinkage for a Simulated Response Y-*
                                 vector

Description

By specifying numerical values for regression parameters (uncorrelated components and error sigma)
that usually are unknown, these functions allow the user to simulate response data and display the
True Squared Error Loss associated with shrinkage along a given **Q**-shaped path.

Usage

```
RXtsimu(form, data, trug, trus, Q = 0, rscale = 1, steps = 8, seed = 0123,
                        qmax = 5, qmin = -5)
```

Arguments

form	A regression formula [y~x1+x2+...] suitable for use with lm().
data	Data frame containing observations on all variables in the formula.
trug	Column vector of numerical values for the true uncorrelated components of the regression coefficient vector.
trus	Numerical value for the true error standard deviation, Sigma.
Q	Numerical value for the shape parameter controling the shrinkage path curvature. Default shape is Q = 0 for Hoerl-Kennard "ordinary" ridge regression.
rscale	One of three possible choices (0, 1 or 2) for rescaling of variables as they are being "centered" to remove non-essential ill-conditioning: 0 implies no rescaling; 1 implies divide each variable by its standard error; 2 implies rescale as in option 1 but re-express answers as in option 0.
steps	Number of equally spaced values per unit change along the horizontal M-extent-of-shrinkage axis where estimates are calculated and displayed in TRACEs (default = 8.)
seed	Seed for random number generator. To get two different simulated response vectors and different sets of coefficients and SE losses, invoke the RXtsimu() function twice with different seed values. (default = 0123.)
qmax	Maximum allowed Q-shape (default = +5.)
qmin	Minimum allowed Q-shape (default = -5.)

Details

The RXridge() functions calculate maximum likelihood estimates (corrected, if necessary, so as
to have correct range) for typical statistical inference situations where regression parameters are
unknowns. In sharp contrast with this usual situation, the RXtsimu() functions show exactly how
regression coefficient estimates and their true Squared Error Losses change with shrinkage for a
simulated response Y-vector generated using given numerical values for regression parameters. In

fact, it is interesting to compare the output from RXtrisk() and RXtsimu() for given regression parameters to the corresponding output from RXridge() on the data.frame in which any original response Y-vector has been replaced by the ydat object from the RXtsimu() output list.

Value

An output list object of class RXtsimu:

form	The regression formula specified as the first argument.
data	Name of the data.frame object specified as the second argument.
trug	Vector of numerical values for the true uncorrelated gamma components.
trus	Numerical value for the true error standard deviation, Sigma.
qp	Numerical value of the Q-shape actually used for shrinkage.
p	Number of regression predictor variables.
n	Number of complete observations after removal of all missing values.
prinstat	Listing of principal statistics.
ydat	Matrix with simulated Y-responses in its first column and the true expected values of those responses in its second column.
coef	Matrix of shrinkage-ridge regression coefficient estimates.
rsel	Matrix of true relative SE losses in regression coefficient estimates.
spat	Matrix of shrinkage pattern multiplicative delta factors.
sext	Listing of summary statistics for all M-extents-of-shrinkage.

Author(s)

Bob Obenchain <wizbob@att.net>

See Also

[RXridge](#) and [RXtrisk](#).

Examples

```
data(haldport)
form <- heat~p3ca+p3cs+p4caf+p2cs
rxrobj <- RXridge(form, data=haldport)
plot(rxrobj)
# define true parameter values.
trugam <- matrix(c(.8,.0,.3,.5),4,1)
trusig <- 0.2
# create true shrinkage MSE risk scenario.
trumse <- RXtrisk(form, data=haldport, trugam, trusig, Q=-5)
# calculate true shrinkage squared error losses.
trusim <- RXtsimu(form, data=haldport, trugam, trusig, Q=-5)
haldpsim <- haldport
haldpsim[,5] <- trusim$ydat[,1]
rxsobj <- RXridge(form, data=haldpsim) # analysis as if parameters unknown
plot(rxsobj)
```

| RXuclars | *Maximum Likelihood Least Angle Regression on Uncorrelated X-Components* |

Description

Apply least angle regression estimation to the uncorrelated components of a possibly ill-conditioned linear regression model and generate normal-theory maximum likelihood TRACE displays.

Usage

```
RXuclars(form, data, rscale = 1, type = "lar", trace = FALSE,
         eps = .Machine$double.eps, omdmin = 9.9e-13, ...)
```

Arguments

form	A regression formula [y~x1+x2+...] suitable for use with lm().
data	Data frame containing observations on all variables in the formula.
rscale	One of three possible choices (0, 1 or 2) for rescaling of variables as they are being "centered" to remove non-essential ill-conditioning: 0 implies no rescaling; 1 implies divide each variable by its standard error; 2 implies rescale as in option 1 but re-express answers as in option 0.
type	One of "lasso", "lar" or "forward.stagewise" for function lars(). Names can be abbreviated to any unique substring. Default in RXlarlso() is "lar".
trace	If TRUE, lars() function prints out its progress.
eps	The effective zero for lars().
omdmin	Strictly positive minimum allowed value for one-minus-delta (default = 9.9e-013.)
...	Optional argument(s) passed to the lars() function in the lars R-package.

Details

RXuclars() applies Least Angle Regression to the uncorrelated components of a possibly ill-conditioned set of X-variables. A closed-form expression for the lars/lasso shrinkage delta factors exits in this case: Delta(i) = max(0,1-k/abs[PC(i)]), where PC(i) is the principal correlation between Y and the i-th principal coordinates of X. Note that the k-factor in this formulation is limited to a subset of [0,1]. MCAL=0 occurs at k=0, while MCAL = P results when k is the maximum absolute principal correlation.

Value

An output list object of class RXuclars:

form	The regression formula specified as the first argument.
data	Name of the data.frame object specified as the second argument.

p	Number of regression predictor variables.
n	Number of complete observations after removal of all missing values.
r2	Numerical value of R-square goodness-of-fit statistic.
s2	Numerical value of the residual mean square estimate of error.
prinstat	Listing of principal statistics.
gmat	Orthogonal matrix of direction cosines for regressor principal axes.
lars	An object of class lars.
coef	Matrix of shrinkage-ridge regression coefficient estimates.
risk	Matrix of MSE risk estimates for fitted coefficients.
exev	Matrix of excess MSE eigenvalues (ordinary least squares minus ridge.)
infd	Matrix of direction cosines for the estimated inferior direction, if any.
spat	Matrix of shrinkage pattern multiplicative delta factors.
mlik	Listing of criteria for maximum likelihood selection of M-extent-of-shrinkage.
sext	Listing of summary statistics for all M-extents-of-shrinkage.

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References

Efron B, Hastie T, Johnstone I, Tibshirani R. (2004) Least angle regression. *Ann. Statis.* **32**, 407-499 (with discussion.)

Obenchain RL. (1994-2005) Shrinkage Regression: ridge, BLUP, Bayes, spline and Stein. **members.iquest.net/~softrx**.

Obenchain RL. (2011) *shrink.PDF* Vignette-like documentation stored in the R library/RXshrink/doc folder. 23 pages.

See Also

[RXlarlso](#).

Examples

```
data(longley2)
form <- GNP~GNP.deflator+Unemployed+Armed.Forces+Population+Year+Employed
rxuobj <- RXuclars(form, data=longley2)
rxuobj
plot(rxuobj)
```

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