Package ‘MASS’

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**Description**

A numeric vector of 31 determinations of nickel content (ppm) in a Canadian syenite rock.

**Usage**

abbey

**Source**


**References**


**Description**

A regular time series giving the monthly totals of accidental deaths in the USA.

**Usage**

accdeaths

**Details**

The values for first six months of 1979 (p. 326) were 7798 7406 8363 8460 9217 9316.
Try All One-Term Additions to a Model

Description

Try fitting all models that differ from the current model by adding a single term from those supplied, maintaining marginality.

This function is generic; there exist methods for classes \texttt{lm} and \texttt{glm} and the default method will work for many other classes.

Usage

```
addterm(object, ...)  
```

## Default S3 method:
```
addterm(object, scope, scale = 0, test = c("none", "Chisq"),  
     k = 2, sorted = FALSE, trace = FALSE, ...)
```

## S3 method for class 'lm'
```
addterm(object, scope, scale = 0, test = c("none", "Chisq", "F"),  
     k = 2, sorted = FALSE, ...)
```

## S3 method for class 'glm'
```
addterm(object, scope, scale = 0, test = c("none", "Chisq", "F"),  
     k = 2, sorted = FALSE, trace = FALSE, ...)
```

Arguments

- **object**: An object fitted by some model-fitting function.
- **scope**: a formula specifying a maximal model which should include the current one. All additional terms in the maximal model with all marginal terms in the original model are tried.
- **scale**: used in the definition of the AIC statistic for selecting the models, currently only for \texttt{lm}, \texttt{aov} and \texttt{glm} models. Specifying scale asserts that the residual standard error or dispersion is known.
- **test**: should the results include a test statistic relative to the original model? The F test is only appropriate for \texttt{lm} and \texttt{aov} models, and perhaps for some over-dispersed \texttt{glm} models. The Chisq test can be an exact test (\texttt{lm} models with known scale) or a likelihood-ratio test depending on the method.
k

the multiple of the number of degrees of freedom used for the penalty. Only \( k=2 \) gives the genuine AIC: \( k = \log(n) \) is sometimes referred to as BIC or SBC.

sorted

should the results be sorted on the value of AIC?

trace

if TRUE additional information may be given on the fits as they are tried.

... arguments passed to or from other methods.

Details

The definition of AIC is only up to an additive constant: when appropriate (lm models with specified scale) the constant is taken to be that used in Mallows’ Cp statistic and the results are labelled accordingly.

Value

A table of class "anova" containing at least columns for the change in degrees of freedom and AIC (or Cp) for the models. Some methods will give further information, for example sums of squares, deviances, log-likelihoods and test statistics.

References


See Also

dropterm, stepAIC

Examples

quine.hi <- aov(log(Days + 2.5) ~ .^4, quine)
quine.lo <- aov(log(Days+2.5) ~ 1, quine)
addterm(quine.lo, quine.hi, test="F")

house.glm0 <- glm(Freq ~ Infl*Type*Cont + Sat, family=poisson, data=housing)
addterm(house.glm0, .~. + Sat:(Infl+Type+Cont), test="Chisq")
house.glm1 <- update(house.glm0, .~. + Sat*(Infl+Type+Cont))
addterm(house.glm1, .~. + Sat:(Infl+Type+Cont)^2, test = "Chisq")

Aids2

Australian AIDS Survival Data

Description

Data on patients diagnosed with AIDS in Australia before 1 July 1991.

Usage

Aids2
Format
This data frame contains 2843 rows and the following columns:

- state: Grouped state of origin: “NSW” includes ACT and “other” is WA, SA, NT and TAS.
- sex: Sex of patient.
- diag: (Julian) date of diagnosis.
- death: (Julian) date of death or end of observation.
- status: “A” (alive) or “D” (dead) at end of observation.
- T.categ: Reported transmission category.
- age: Age (years) at diagnosis.

Note
This data set has been slightly jittered as a condition of its release, to ensure patient confidentiality.

Source
Dr P. J. Solomon and the Australian National Centre in HIV Epidemiology and Clinical Research.

References

---

**Animals**  
**Brain and Body Weights for 28 Species**

Description
Average brain and body weights for 28 species of land animals.

Usage
Animals

Format
body: body weight in kg.

brain: brain weight in g.

Note
The name Animals avoids conflicts with a system dataset animals in S-PLUS 4.5 and later.

Source
anorexia

References


---

anorexia  Anorexia Data on Weight Change

Description

The anorexia data frame has 72 rows and 3 columns. Weight change data for young female anorexia patients.

Usage

anorexia

Format

This data frame contains the following columns:

- **treat**: Factor of three levels: "Cont" (control), "CBT" (Cognitive Behavioural treatment) and "FT" (family treatment).
- **prewt**: Weight of patient before study period, in lbs.
- **postwt**: Weight of patient after study period, in lbs.

Source


(Note that the original source mistakenly says that weights are in kg.)

References

Description

Method function to perform sequential likelihood ratio tests for Negative Binomial generalized linear models.

Usage

## S3 method for class 'negbin'
anova(object, ..., test = "Chisq")

Arguments

- **object**: Fitted model object of class "negbin", inheriting from classes "glm" and "lm", specifying a Negative Binomial fitted GLM. Typically the output of `glm.nb()`.
- **...**: Zero or more additional fitted model objects of class "negbin". They should form a nested sequence of models, but need not be specified in any particular order.
- **test**: Argument to match the test argument of `anova.glm`. Ignored (with a warning if changed) if a sequence of two or more Negative Binomial fitted model objects is specified, but possibly used if only one object is specified.

Details

This function is a method for the generic function `anova()` for class "negbin". It can be invoked by calling `anova(x)` for an object `x` of the appropriate class, or directly by calling `anova.negbin(x)` regardless of the class of the object.

Note

If only one fitted model object is specified, a sequential analysis of deviance table is given for the fitted model. The theta parameter is kept fixed. If more than one fitted model object is specified they must all be of class "negbin" and likelihood ratio tests are done of each model within the next. In this case theta is assumed to have been re-estimated for each model.

References


See Also

glm.nb, negative.binomial, summary.negbin
Examples

```r
m1 <- glm.nb(Days ~ Eth*Age*Lrn*Sex, quine, link = log)
m2 <- update(m1, . ~ . - Eth:Age:Lrn:Sex)
anova(m2, m1)
anova(m2)
```

Description

Integrate a function of one variable over a finite range using a recursive adaptive method. This function is mainly for demonstration purposes.

Usage

```r
area(f, a, b, ..., fa = f(a, ...), fb = f(b, ...),
     limit = 10, eps = 1e-05)
```

Arguments

- `f`: The integrand as an S function object. The variable of integration must be the first argument.
- `a`: Lower limit of integration.
- `b`: Upper limit of integration.
- `...`: Additional arguments needed by the integrand.
- `fa`: Function value at the lower limit.
- `fb`: Function value at the upper limit.
- `limit`: Limit on the depth to which recursion is allowed to go.
- `eps`: Error tolerance to control the process.

Details

The method divides the interval in two and compares the values given by Simpson’s rule and the trapezium rule. If these are within `eps` of each other the Simpson’s rule result is given, otherwise the process is applied separately to each half of the interval and the results added together.

Value

The integral from `a` to `b` of `f(x)`.

References

Examples

\[
\text{area(sin, 0, pi)} \quad \# \text{ integrate the sin function from 0 to pi.}
\]

---

**bacteria**  
*Presence of Bacteria after Drug Treatments*

---

**Description**

Tests of the presence of the bacteria *H. influenzae* in children with otitis media in the Northern Territory of Australia.

**Usage**

`bacteria`

**Format**

This data frame has 220 rows and the following columns:

- `y`: presence or absence: a factor with levels `n` and `y`.
- `ap`: active/placebo: a factor with levels `a` and `p`.
- `hilo`: hi/low compliance: a factor with levels `hi` and `lo`.
- `week`: numeric: week of test.
- `ID`: subject ID: a factor.
- `trt`: a factor with levels `placebo`, `drug` and `drug+`, a re-coding of `ap` and `hilo`.

**Details**

Dr A. Leach tested the effects of a drug on 50 children with a history of otitis media in the Northern Territory of Australia. The children were randomized to the drug or the a placebo, and also to receive active encouragement to comply with taking the drug.

The presence of *H. influenzae* was checked at weeks 0, 2, 4, 6 and 11: 30 of the checks were missing and are not included in this data frame.

**Source**

Dr Amanda Leach via Mr James McBroom.

**References**


Examples

```r
contrasts(bacteria$trt) <- structure(contr.sdif(3),
   dimnames = list(NULL, c("drug", "encourage")))
## fixed effects analyses
summary(glm(y ~ trt * week, binomial, data = bacteria))
summary(glm(y ~ trt + week, binomial, data = bacteria))
summary(glm(y ~ trt + I(week > 2), binomial, data = bacteria))

# conditional random-effects analysis
library(survival)
bacteria$Time <- rep(1, nrow(bacteria))
coxph(Surv(Time, unclass(y)) ~ week + strata(ID),
   data = bacteria, method = "exact")
coxph(Surv(Time, unclass(y)) ~ factor(week) + strata(ID),
   data = bacteria, method = "exact")
coxph(Surv(Time, unclass(y)) ~ I(week > 2) + strata(ID),
   data = bacteria, method = "exact")

# PQL glmm analysis
library(nlme)
summary(glmmPQL(y ~ trt + I(week > 2), random = ~ 1 | ID,
   family = binomial, data = bacteria))
```

---

**bandwidth.nrd**  
*Bandwidth for density() via Normal Reference Distribution*

**Description**

A well-supported rule-of-thumb for choosing the bandwidth of a Gaussian kernel density estimator.

**Usage**

`bandwidth.nrd(x)`

**Arguments**

- `x`  
  A data vector.

**Value**

A bandwidth on a scale suitable for the `width` argument of `density`.

**References**

Examples

```r
# The function is currently defined as
definition
{
  r <- quantile(x, c(0.25, 0.75))
  h <- (r[2] - r[1])/1.34
  4 * 1.06 * min(sqrt(var(x)), h) * length(x)^(-1/5)
}
```

Description

Uses biased cross-validation to select the bandwidth of a Gaussian kernel density estimator.

Usage

```r
bcv(x, nb = 1000, lower, upper)
```

Arguments

- `x`: a numeric vector
- `nb`: number of bins to use.
- `lower, upper`: Range over which to minimize. The default is almost always satisfactory.

Value

a bandwidth

References


See Also

`ucv`, `width.SJ`, `density`

Examples

```r
bcv(geyser$duration)
```
beav1

---

**Body Temperature Series of Beaver 1**

---

**Description**

Reynolds (1994) describes a small part of a study of the long-term temperature dynamics of beaver *Castor canadensis* in north-central Wisconsin. Body temperature was measured by telemetry every 10 minutes for four females, but data from a one period of less than a day for each of two animals is used there.

**Usage**

beav1

**Format**

The beav1 data frame has 114 rows and 4 columns. This data frame contains the following columns:

- **day**  Day of observation (in days since the beginning of 1990), December 12–13.
- **time**  Time of observation, in the form 0330 for 3.30am.
- **temp**  Measured body temperature in degrees Celsius.
- **activ**  Indicator of activity outside the retreat.

**Note**

The observation at 22:20 is missing.

**Source**


**References**


**See Also**

beav2
Examples

```r
beav1 <- within(beav1,
    hours <- 24*(day-346) + trunc(time/100) + (time%%100)/60
) plot(beav1$hours, beav1$temp, type="l", xlab="time",
    ylab="temperature", main="Beaver 1")
usr <- par("usr"); usr[3:4] <- c(-0.2, 8); par(usr=usr)
lines(beav1$hours, beav1$activ, type="s", lty=2)
temp <- ts(c(beav1$temp[1:82], NA, beav1$temp[83:114]),
    start = 9.5, frequency = 6)
activ <- ts(c(beav1$activ[1:82], NA, beav1$activ[83:114]),
    start = 9.5, frequency = 6)

acf(temp[1:53])
acf(temp[1:53], type = "partial")
ar(temp[1:53])
act <- c(rep(0, 10), activ)
X <- cbind(1, act = act[11:125], act1 = act[10:124],
    act2 = act[9:123], act3 = act[8:122])
alpha <- 0.80
stemp <- as.vector(temp - alpha*lag(temp, -1))
sX <- X[-1, ] - alpha * X[-115,]
beav1.ls <- lm(stemp ~ -1 + sX, na.action = na.omit)
summary(beav1.ls, cor = FALSE)
rm(temp, activ)
```

Description

Reynolds (1994) describes a small part of a study of the long-term temperature dynamics of beaver Castor canadensis in north-central Wisconsin. Body temperature was measured by telemetry every 10 minutes for four females, but data from a one period of less than a day for each of two animals is used there.

Usage

```r
beav2
```

Format

The beav2 data frame has 100 rows and 4 columns. This data frame contains the following columns:

day  Day of observation (in days since the beginning of 1990), November 3–4.
time  Time of observation, in the form 0330 for 3.30am.
temp  Measured body temperature in degrees Celsius.
activ  Indicator of activity outside the retreat.
Source


References


See Also

beav1

Examples

attach(beav2)
beav2$hours <- 24*(day-307) + trunc(time/100) + (time%%100)/60
plot(beav2$hours, beav2$temp, type = "l", xlab = "time",
     ylab = "temperature", main = "Beaver 2")
usr <- par("usr"); usr[3:4] <- c(-0.2, 8); par(usr = usr)
lines(beav2$hours, beav2$activ, type = "s", lty = 2)

temp <- ts(temp, start = 8+2/3, frequency = 6)
activ <- ts activ, start = 8+2/3, frequency = 6)
acf(temp[activ == 0]); acf(temp[activ == 1]) # also look at PACFs
ar(temp[activ == 0]); ar(temp[activ == 1])
arima(temp, order = c(1,0,0), xreg = activ)
dreg <- cbind(sin = sin(2*pi*beav2$hours/24), cos = cos(2*pi*beav2$hours/24))
arima(temp, order = c(1,0,0), xreg = cbind(activ=activ, dreg))

library(nlme) # for gls and corAR1
beav2.gls <- gls(temp ~ activ, data = beav2, corr = corAR1(0.8),
                  method = "ML")
summary(beav2.gls)
summary(update(beav2.gls, subset = 6:100))
detach("beav2"); rm(temp, activ)

Belgian-phones

Belgium Phone Calls 1950-1973

Description

A list object with the annual numbers of telephone calls, in Belgium. The components are:

year  last two digits of the year.
calls  number of telephone calls made (in millions of calls).
Usage

phones

Source


References


biopsy

Biopsy Data on Breast Cancer Patients

Description

This breast cancer database was obtained from the University of Wisconsin Hospitals, Madison from Dr. William H. Wolberg. He assessed biopsies of breast tumours for 699 patients up to 15 July 1992; each of nine attributes has been scored on a scale of 1 to 10, and the outcome is also known. There are 699 rows and 11 columns.

Usage

biopsy

Format

This data frame contains the following columns:

- ID sample code number (not unique).
- V1 clump thickness.
- V2 uniformity of cell size.
- V3 uniformity of cell shape.
- V4 marginal adhesion.
- V5 single epithelial cell size.
- V6 bare nuclei (16 values are missing).
- V7 bland chromatin.
- V8 normal nucleoli.
- V9 mitoses.

class "benign" or "malignant".
**Source**


**References**


---

**birthwt**

*Risk Factors Associated with Low Infant Birth Weight*

**Description**

The `birthwt` data frame has 189 rows and 10 columns. The data were collected at Baystate Medical Center, Springfield, Mass during 1986.

**Usage**

`birthwt`

**Format**

This data frame contains the following columns:

- `low` indicator of birth weight less than 2.5 kg.
- `age` mother’s age in years.
- `lwt` mother’s weight in pounds at last menstrual period.
- `race` mother’s race (1 = white, 2 = black, 3 = other).
- `smoke` smoking status during pregnancy.
- `ptl` number of previous premature labours.
- `ht` history of hypertension.
ui  presence of uterine irritability.
ftv  number of physician visits during the first trimester.
bwt  birth weight in grams.

Source

References

Examples

```r
bwt <- with(birthwt, {
  race <- factor(race, labels = c("white", "black", "other"))
  ptd <- factor(pt1 > 0)
  ftv <- factor(ftv)
  levels(ftv)[-c(1:2)] <- "2+
  data.frame(low = factor(low), age, lwt, race, smoke = (smoke > 0),
    ptd, htr = (ht > 0), ui = (ui > 0), ftv)
})
options(contrasts = c("contr.treatment", "contr.poly"))
glm(low ~ ., binomial, bwt)
```

---

**Boston**

*Housing Values in Suburbs of Boston*

---

Description
The Boston data frame has 506 rows and 14 columns.

Usage
Boston

Format
This data frame contains the following columns:

- **crim** per capita crime rate by town.
- **zn** proportion of residential land zoned for lots over 25,000 sq.ft.
- **indus** proportion of non-retail business acres per town.
- **chas** Charles River dummy variable (= 1 if tract bounds river; 0 otherwise).
- **nox** nitrogen oxides concentration (parts per 10 million).
- **rm** average number of rooms per dwelling.
- **age** proportion of owner-occupied units built prior to 1940.
dis  weighted mean of distances to five Boston employment centres.
rad  index of accessibility to radial highways.
tax  full-value property-tax rate per \$10,000.
ptratio  pupil-teacher ratio by town.
black \(1000(Bk - 0.63)^2\) where \(Bk\) is the proportion of blacks by town.
lstat  lower status of the population (percent).
medv  median value of owner-occupied homes in \$1000s.

Source


---

**boxcox**

*Box-Cox Transformations for Linear Models*

**Description**
Computes and optionally plots profile log-likelihoods for the parameter of the Box-Cox power transformation.

**Usage**

```r
boxcox(object, ...)  
```

## Default S3 method:
```
boxcox(object, lambda = seq(-2, 2, 1/10), plotit = TRUE,  
       interp, eps = 1/50, xlab = expression(lambda),  
       ylab = "log-Likelihood", ...)
```

## S3 method for class 'formula'
```
boxcox(object, lambda = seq(-2, 2, 1/10), plotit = TRUE,  
       interp, eps = 1/50, xlab = expression(lambda),  
       ylab = "log-Likelihood", ...)
```

## S3 method for class 'lm'
```
boxcox(object, lambda = seq(-2, 2, 1/10), plotit = TRUE,  
       interp, eps = 1/50, xlab = expression(lambda),  
       ylab = "log-Likelihood", ...)
```
Arguments

- **object**: a formula or fitted model object. Currently only `lm` and `aov` objects are handled.
- **lambda**: vector of values of lambda – default \((-2, 2)\) in steps of 0.1.
- **plotit**: logical which controls whether the result should be plotted.
- **interp**: logical which controls whether spline interpolation is used. Default to TRUE if plotting with `lambda` of length less than 100.
- **eps**: Tolerance for `lambda`; defaults to 0.02.
- **xlab**: defaults to "lambda".
- **ylab**: defaults to "log-Likelihood".
- **...**: additional parameters to be used in the model fitting.

Value

A list of the `lambda` vector and the computed profile log-likelihood vector, invisibly if the result is plotted.

Side Effects

If `plotit = TRUE` plots log-likelihood vs `lambda` and indicates a 95% confidence interval about the maximum observed value of `lambda`. If `interp = TRUE`, spline interpolation is used to give a smoother plot.

References


Examples

```r
boxcox(Volume ~ log(Height) + log(Girth), data = trees,
       lambda = seq(-0.25, 0.25, length = 10))
boxcox(Days+1 ~ Eth*Sex*Age*Lrn, data = quine,
       lambda = seq(-0.05, 0.45, len = 20))
```

---

cabbages

*Data from a cabbage field trial*

Description

The cabbages data set has 60 observations and 4 variables

Usage

cabbages
**caith**

**Format**

This data frame contains the following columns:

- **Cult**  Factor giving the cultivar of the cabbage, two levels: c39 and c52.
- **Date**  Factor specifying one of three planting dates: d16, d20 or d21.
- **Headwt**  Weight of the cabbage head, presumably in kg.
- **VitC**  Ascorbic acid content, in undefined units.

**Source**


**References**


---

**caith**  

*Colours of Eyes and Hair of People in Caithness*

**Description**

Data on the cross-classification of people in Caithness, Scotland, by eye and hair colour. The region of the UK is particularly interesting as there is a mixture of people of Nordic, Celtic and Anglo-Saxon origin.

**Usage**

caith

**Format**

A 4 by 5 table with rows the eye colours (blue, light, medium, dark) and columns the hair colours (fair, red, medium, dark, black).

**Source**


**References**

Examples

corresp(caith)
dimnames(caith)[[2]] <- c("F", "R", "M", "D", "B")
par(mfcol=c(1,3))
plot(corresp(caith, nf=2)); title("symmetric")
plot(corresp(caith, nf=2), type="rows"); title("rows")
plot(corresp(caith, nf=2), type="col"); title("columns")
par(mfrow=c(1,1))

Cars93

Data from 93 Cars on Sale in the USA in 1993

Description

The Cars93 data frame has 93 rows and 27 columns.

Usage

Cars93

Format

This data frame contains the following columns:

- **manufacturer**: Manufacturer.
- **model**: Model.
- **type**: Type: a factor with levels "Small", "Sporty", "Compact", "Midsize", "Large" and "Van".
- **minPrice**: Minimum Price (in \$1,000): price for a basic version.
- **price**: Midrange Price (in \$1,000): average of Min.Price and Max.Price.
- **maxPrice**: Maximum Price (in \$1,000): price for "a premium version".
- **mpgCity**: City MPG (miles per US gallon by EPA rating).
- **mpgHighway**: Highway MPG.
- **airbags**: Air Bags standard. Factor: none, driver only, or driver & passenger.
- **driveTrain**: Drive train type: rear wheel, front wheel or 4WD; (factor).
- **cylinders**: Number of cylinders (missing for Mazda RX-7, which has a rotary engine).
- **engineSize**: Engine size (litres).
- **horsepower**: Horsepower (maximum).
- **rpm**: RPM (revs per minute at maximum horsepower).
- **revPerMile**: Engine revolutions per mile (in highest gear).
- **manTransAvail**: Is a manual transmission version available? (yes or no, Factor).
- **fuelTankCapacity**: Fuel tank capacity (US gallons).
- **passengers**: Passenger capacity (persons)
Details

Cars were selected at random from among 1993 passenger car models that were listed in both the Consumer Reports issue and the PACE Buying Guide. Pickup trucks and Sport/Utility vehicles were eliminated due to incomplete information in the Consumer Reports source. Duplicate models (e.g., Dodge Shadow and Plymouth Sundance) were listed at most once.

Further description can be found in Lock (1993).

Source


References


---

cats  
Anatomical Data from Domestic Cats

Description

The heart and body weights of samples of male and female cats used for digitalis experiments. The cats were all adult, over 2 kg body weight.

Usage

cats

Format

This data frame contains the following columns:

- Sex  sex: Factor with evels "F" and "M".
- Bwt  body weight in kg.
- Hwt  heart weight in g.
Source


References


---

**cement**

*Heat Evolved by Setting Cements*

Description

Experiment on the heat evolved in the setting of each of 13 cements.

Usage
cement

Format

\[ x_1, \ x_2, \ x_3, \ x_4 \] Proportions (%) of active ingredients.

\[ y \] heat evolved in cals/gm.

Details

Thirteen samples of Portland cement were set. For each sample, the percentages of the four main chemical ingredients was accurately measured. While the cement was setting the amount of heat evolved was also measured.

Source


References


Examples

\[
\text{lm}(y \sim x_1 + x_2 + x_3 + x_4, \text{cement})
\]
chem

---

Copper in Wholemeal Flour

Description

A numeric vector of 24 determinations of copper in wholemeal flour, in parts per million.

Usage

chem

Source


References


---

con2tr

Convert Lists to Data Frames for use by lattice

Description

Convert lists to data frames for use by lattice.

Usage

con2tr(obj)

Arguments

obj A list of components x, y and z as passed to contour.

Details

con2tr repeats the x and y components suitably to match the vector z.

Value

A data frame suitable for passing to lattice (formerly trellis) functions.

References

Confidence Intervals for Model Parameters

Description
Computes confidence intervals for one or more parameters in a fitted model. Package MASS adds methods for glm and nls fits.

Usage
```r
## S3 method for class 'glm'
confint(object, parm, level = 0.95, trace = FALSE, ...)
```
```r
## S3 method for class 'nls'
confint(object, parm, level = 0.95, ...)
```

Arguments
- `object`: a fitted model object. Methods currently exist for the classes "glm", "nls" and for profile objects from these classes.
- `parm`: a specification of which parameters are to be given confidence intervals, either a vector of numbers or a vector of names. If missing, all parameters are considered.
- `level`: the confidence level required.
- `trace`: logical. Should profiling be traced?
- `...`: additional argument(s) for methods.

Details
`confint` is a generic function in package stats.
These `confint` methods call the appropriate profile method, then find the confidence intervals by interpolation in the profile traces. If the profile object is already available it should be used as the main argument rather than the fitted model object itself.

Value
A matrix (or vector) with columns giving lower and upper confidence limits for each parameter. These will be labelled as (1 - level)/2 and 1 - (1 - level)/2 in % (by default 2.5% and 97.5%).

References

See Also
`confint` (the generic and "lm" method), `profile`
Examples

```r
expn1 <- deriv(y - b0 + b1 * 2^(x/th), c("b0", "b1", "th"),
    function(b0, b1, th, x) {})

wtloss.gr <- nls(Weight ~ expn1(b0, b1, th, Days),
    data = wtloss, start = c(b0=90, b1=95, th=120))

expn2 <- deriv(-b0 + b1*((w0 - b0)/b1)^(x/d0),
    c("b0","b1","d0"), function(b0, b1, d0, x, w0) {})

wtloss.init <- function(obj, w0) {
    p <- coef(obj)
    d0 <- - log((w0 - p["b0"])/p["b1"]) / log(2) * p["th"]
    c(p[c("b0", "b1")], d0 = as.vector(d0))
}

out <- NULL
w0s <- c(110, 100, 90)
for(w0 in w0s) {
    fm <- nls(Weight ~ expn2(b0, b1, d0, Days, w0),
        wtloss, start = wtloss.init(wtloss.gr, w0))
    out <- rbind(out, c(coef(fm)["d0"], confint(fm, "d0")))
}

dimnames(out) <- list(paste(w0s, "kg"), c("d0", "low", "high"))
out

ldose <- rep(0:5, 2)
umdead <- c(1, 4, 9, 13, 18, 20, 0, 2, 6, 10, 12, 16)
sex <- factor(rep("M", "F"), c(6, 6)))
SF <- cbind(numdead, numalive = 20 - numdead)
budworm.lg0 <- glm(SF ~ sex + ldose - 1, family = binomial)
confint(budworm.lg0)
confint(budworm.lg0, "ldose")
```

---

**contr.sdif**

*Successive Differences Contrast Coding*

**Description**

A coding for factors based on successive differences.

**Usage**

`contr.sdif(n, contrasts = TRUE, sparse = FALSE)`

**Arguments**

- `n` The number of levels required.
contrasts logical: Should there be \( n - 1 \) columns orthogonal to the mean (the default) or \( n \) columns spanning the space?

sparse logical. If true and the result would be sparse (only true for contrasts = FALSE), return a sparse matrix.

Details

The contrast coefficients are chosen so that the coded coefficients in a one-way layout are the differences between the means of the second and first levels, the third and second levels, and so on. This makes most sense for ordered factors, but does not assume that the levels are equally spaced.

Value

If contrasts is TRUE, a matrix with \( n \) rows and \( n - 1 \) columns, and the \( n \) by \( n \) identity matrix if contrasts is FALSE.

References


See Also

contr.treatment, contr.sum, contr.helmert.

Examples

```r
(A <- contr.sdif(6))
zapsmall(ginv(A))
```

Description

Seven specimens were sent to 6 laboratories in 3 separate batches and each analysed for Analyte. Each analysis was duplicated.

Usage

coop

Format

This data frame contains the following columns:

- **Lab** Laboratory, L1, L2, ..., L6.
- **Spc** Specimen, S1, S2, ..., S7.
- **Bat** Batch, B1, B2, B3 (nested within Spc/Lab),
- **Conc** Concentration of Analyte in \( g/kg \).
**Source**


**References**


**See Also**

chem, abbey.

---

**corresp**  
*Simple Correspondence Analysis*

**Description**

Find the principal canonical correlation and corresponding row- and column-scores from a correspondence analysis of a two-way contingency table.

**Usage**

```r
corresp(x, ...)  
```

```
## S3 method for class 'matrix'
corresp(x, nf = 1, ...)
```

```
## S3 method for class 'factor'
corresp(x, y, ...)
```

```
## S3 method for class 'data.frame'
corresp(x, ...)
```

```
## S3 method for class 'xtabs'
corresp(x, ...)
```

```
## S3 method for class 'formula'
corresp(formula, data, ...)
```

**Arguments**

- `x, formula`  
The function is generic, accepting various forms of the principal argument for specifying a two-way frequency table. Currently accepted forms are matrices, data frames (coerced to frequency tables), objects of class "xtabs" and formulae of the form `~ F1 + F2`, where F1 and F2 are factors.

- `nf`  
The number of factors to be computed. Note that although 1 is the most usual, one school of thought takes the first two singular vectors for a sort of biplot.
y 

data 

If the principal argument is a formula, a data frame may be specified as well from which variables in the formula are preferentially satisfied.

Details

See Venables & Ripley (2002). The plot method produces a graphical representation of the table if nf=1, with the areas of circles representing the numbers of points. If nf is two or more the biplot method is called, which plots the second and third columns of the matrices A = Dr^(-1/2) UV and B = Dr^(-1/2) VL where the singular value decomposition is UV. Thus the x-axis is the canonical correlation times the row and column scores. Although this is called a biplot, it does not have any useful inner product relationship between the row and column scores. Think of this as an equally-scaled plot with two unrelated sets of labels. The origin is marked on the plot with a cross. (For other versions of this plot see the book.)

Value

An list object of class "correspondence" for which print, plot and biplot methods are supplied. The main components are the canonical correlation(s) and the row and column scores.

References


See Also

svd, princomp.

Examples

(ct <- corresp(~ Age + Eth, data = quine))
plot(ct)
corresp(caith)
biplot(corresp(caith, nf = 2))

Description

Compute a multivariate location and scale estimate with a high breakdown point – this can be thought of as estimating the mean and covariance of the good part of the data. cov.mve and cov.mcd are compatibility wrappers.
Usage

cov.rob(x, cor = FALSE, quantile.used = floor((n + p + 1)/2),
method = c("mve", "mcd", "classical"),
nsamp = "best", seed)

cov.mve(...)
cov.mcd(...)

Arguments

x a matrix or data frame.
cor should the returned result include a correlation matrix?
quantile.used the minimum number of the data points regarded as good points.
method the method to be used – minimum volume ellipsoid, minimum covariance determinant or classical product-moment. Using cov.mve or cov.mcd forces mve or mcd respectively.
nsamp the number of samples or "best" or "exact" or "sample". If "sample" the number chosen is min(5*p, 3000), taken from Rousseeuw and Hubert (1997). If "best" exhaustive enumeration is done up to 5000 samples: if "exact" exhaustive enumeration will be attempted however many samples are needed.
seed the seed to be used for random sampling: see RNGkind. The current value of .Random.seed will be preserved if it is set.
... arguments to cov.rob other than method.

Details

For method "mve", an approximate search is made of a subset of size quantile.used with an enclosing ellipsoid of smallest volume; in method "mcd" it is the volume of the Gaussian confidence ellipsoid, equivalently the determinant of the classical covariance matrix, that is minimized. The mean of the subset provides a first estimate of the location, and the rescaled covariance matrix a first estimate of scatter. The Mahalanobis distances of all the points from the location estimate for this covariance matrix are calculated, and those points within the 97.5% point under Gaussian assumptions are declared to be good. The final estimates are the mean and rescaled covariance of the good points.

The rescaling is by the appropriate percentile under Gaussian data; in addition the first covariance matrix has an ad hoc finite-sample correction given by Marazzi.

For method "mve" the search is made over ellipsoids determined by the covariance matrix of p of the data points. For method "mcd" an additional improvement step suggested by Rousseeuw and van Driessen (1999) is used, in which once a subset of size quantile.used is selected, an ellipsoid based on its covariance is tested (as this will have no larger a determinant, and may be smaller).

Value

A list with components

center the final estimate of location.
Estimates a covariance or correlation matrix assuming the data came from a multivariate t distribution: this provides some degree of robustness to outlier without giving a high breakdown point.

Usage

```r
 cov.trob(x, wt = rep(1, n), cor = FALSE, center = TRUE, nu = 5,
          maxit = 25, tol = 0.01)
```
cov.trob

Arguments

  x  data matrix. Missing values (NAs) are not allowed.
  wt A vector of weights for each case: these are treated as if the case i actually
      occurred wt[i] times.
  cor Flag to choose between returning the correlation (cor = TRUE) or covariance
       (cor = FALSE) matrix.
  center a logical value or a numeric vector providing the location about which the co-
        variance is to be taken. If center = FALSE, no centering is done; if center = TRUE
        the MLE of the location vector is used.
  nu  ‘degrees of freedom’ for the multivariate t distribution. Must exceed 2 (so that
       the covariance matrix is finite).
  maxit Maximum number of iterations in fitting.
  tol  Convergence tolerance for fitting.

Value

A list with the following components

  cov  the fitted covariance matrix.
  center the estimated or specified location vector.
  wt  the specified weights: only returned if the wt argument was given.
  n.obs  the number of cases used in the fitting.
  cor  the fitted correlation matrix: only returned if cor = TRUE.
  call  The matched call.
  iter  The number of iterations used.

References

J. T. Kent, D. E. Tyler and Y. Vardi (1994) A curious likelihood identity for the multivariate t-

      Springer.

See Also

cov, cov.wt, cov.mve

Examples

cov.trob(stackloss)
Description

A relative performance measure and characteristics of 209 CPUs.

Usage

cpus

Format

The components are:

name  manufacturer and model.
syc t  cycle time in nanoseconds.
mmin  minimum main memory in kilobytes.
mmax  maximum main memory in kilobytes.
cach  cache size in kilobytes.
chmin minimum number of channels.
chmax maximum number of channels.
perf  published performance on a benchmark mix relative to an IBM 370/158-3.
estperf estimated performance (by Ein-Dor & Feldmesser).

Source


References

Morphological Measurements on Leptograpsus Crabs

Description

The crabs data frame has 200 rows and 8 columns, describing 5 morphological measurements on 50 crabs each of two colour forms and both sexes, of the species *Leptograpsus variegatus* collected at Fremantle, W. Australia.

Usage

```
crabs
```

Format

This data frame contains the following columns:

- **sp** species - "B" or "O" for blue or orange.
- **sex** as it says.
- **index** index 1:50 within each of the four groups.
- **FL** frontal lobe size (mm).
- **RW** rear width (mm).
- **CL** carapace length (mm).
- **CW** carapace width (mm).
- **BD** body depth (mm).

Source


References

Cushings

*Diagnostic Tests on Patients with Cushing's Syndrome*

**Description**

Cushing’s syndrome is a hypertensive disorder associated with over-secretion of cortisol by the adrenal gland. The observations are urinary excretion rates of two steroid metabolites.

**Usage**

Cushings

**Format**

The Cushings data frame has 27 rows and 3 columns:

- **Tetrahydrocortisone** urinary excretion rate (mg/24hr) of Tetrahydrocortisone.
- **Pregnanetriol** urinary excretion rate (mg/24hr) of Pregnanetriol.
- **Type** underlying type of syndrome, coded a (adenoma), b (bilateral hyperplasia), c (carcinoma) or u for unknown.

**Source**


**References**


DDT

*DDT in Kale*

**Description**

A numeric vector of 15 measurements by different laboratories of the pesticide DDT in kale, in ppm (parts per million) using the multiple pesticide residue measurement.

**Usage**

DDT

**Source**


deaths

Monthly Deaths from Lung Diseases in the UK

Description
A time series giving the monthly deaths from bronchitis, emphysema and asthma in the UK, 1974-1979, both sexes (deaths),

Usage
deaths

Source

References

See Also
This the same as dataset ldeaths in R's datasets package.

denumerator

Transform an Allowable Formula for 'loglm' into one for 'terms'

Description
loglm allows dimension numbers to be used in place of names in the formula. denumerator modifies such a formula into one that terms can process.

Usage
denumerator(x)

Arguments
x A formula conforming to the conventions of loglm, that is, it may allow dimension numbers to stand in for names when specifying a log-linear model.
Details

The model fitting function \texttt{loglm} fits log-linear models to frequency data using iterative proportional scaling. To specify the model the user must nominate the margins in the data that remain fixed under the log-linear model. It is convenient to allow the user to use dimension numbers, 1, 2, 3, \ldots for the first, second, third, \ldots, margins in a similar way to variable names. As the model formula has to be parsed by \texttt{terms}, which treats 1 in a special way and requires parseable variable names, these formulae have to be modified by giving genuine names for these margin, or dimension numbers. \texttt{denumerate} replaces these numbers with names of a special form, namely \texttt{n} is replaced by \texttt{.vn}. This allows \texttt{terms} to parse the formula in the usual way.

Value

A linear model formula like that presented, except that where dimension numbers, say \texttt{n}, have been used to specify fixed margins these are replaced by names of the form \texttt{.vn} which may be processed by \texttt{terms}.

See Also

\texttt{renumerate}

Examples

\begin{verbatim}
denumerate(~(1+2+3)^3 + a/b)
## which gives ~(v1 + v2 + v3)^3 + a/b
\end{verbatim}

\begin{verbatim}
dose.p

\textit{Predict Doses for Binomial Assay model}
\end{verbatim}

Description

Calibrate binomial assays, generalizing the calculation of LD50.

Usage

\begin{verbatim}
dose.p(obj, cf = 1:2, p = 0.5)
\end{verbatim}

Arguments

\begin{itemize}
  \item \texttt{obj} A fitted model object of class inheriting from "\texttt{glm}".
  \item \texttt{cf} The terms in the coefficient vector giving the intercept and coefficient of (log-)dose
  \item \texttt{p} Probabilities at which to predict the dose needed.
\end{itemize}

Value

An object of class "\texttt{glm.dose}" giving the prediction (attribute "\texttt{p}" and standard error (attribute "\texttt{SE}") at each response probability.
Drivers

Deaths of Car Drivers in Great Britain 1969-84

Description

A regular time series giving the monthly totals of car drivers in Great Britain killed or seriously injured Jan 1969 to Dec 1984. Compulsory wearing of seat belts was introduced on 31 Jan 1983.

Usage

drivers

Source


References


Examples

```r
ldose <- rep(0:5, 2)
numdead <- c(7, 4, 9, 13, 18, 20, 0, 2, 6, 10, 12, 16)
sex <- factor(rep(c("M", "F"), c(6, 6)))
SF <- cbind(numdead, numalive = 20 - numdead)
budworm.lg0 <- glm(SF - sex + ldose - 1, family = binomial)
dose.p(budworm.lg0, cf = c(1,3), p = 1:3/4)
dose.p(update(budworm.lg0, family = binomial(link=probit)),
       cf = c(1,3), p = 1:3/4)
```
Try All One-Term Deletions from a Model

Description

Try fitting all models that differ from the current model by dropping a single term, maintaining marginality.

This function is generic; there exist methods for classes `lm` and `glm` and the default method will work for many other classes.

Usage

dropterm(object, ...)

## Default S3 method:
dropterm(object, scope, scale = 0, test = c("none", "Chisq"),
  k = 2, sorted = FALSE, trace = FALSE, ...)

## S3 method for class 'lm'
dropterm(object, scope, scale = 0, test = c("none", "Chisq", "F"),
  k = 2, sorted = FALSE, ...)

## S3 method for class 'glm'
dropterm(object, scope, scale = 0, test = c("none", "Chisq", "F"),
  k = 2, sorted = FALSE, trace = FALSE, ...)

Arguments

- **object**: A object fitted by some model-fitting function.
- **scope**: a formula giving terms which might be dropped. By default, the model formula. Only terms that can be dropped and maintain marginality are actually tried.
- **scale**: used in the definition of the AIC statistic for selecting the models, currently only for `lm`, `aov` and `glm` models. Specifying `scale` asserts that the residual standard error or dispersion is known.
- **test**: should the results include a test statistic relative to the original model? The F test is only appropriate for `lm` and `aov` models, and perhaps for some over-dispersed `glm` models. The Chisq test can be an exact test (`lm` models with known scale) or a likelihood-ratio test depending on the method.
- **k**: the multiple of the number of degrees of freedom used for the penalty. Only \( k = 2 \) gives the genuine AIC: \( k = \log(n) \) is sometimes referred to as BIC or SBC.
- **sorted**: should the results be sorted on the value of AIC?
- **trace**: if TRUE additional information may be given on the fits as they are tried.
- **...**: arguments passed to or from other methods.
Details

The definition of AIC is only up to an additive constant: when appropriate (lm models with specified scale) the constant is taken to be that used in Mallows’ Cp statistic and the results are labelled accordingly.

Value

A table of class "anova" containing at least columns for the change in degrees of freedom and AIC (or Cp) for the models. Some methods will give further information, for example sums of squares, deviances, log-likelihoods and test statistics.

References


See Also

addterm, stepAIC

Examples

quine.6 <- aov(log(Days + 2.5) ~ .^4, quine)
quine.nxt <- update(quine.6, . ~ . - Eth:Sex:Age:Lrn)
dropterm(quine.nxt, test = "F")
quine.sp <- stepAIC(quine.nxt,
    scope = list(upper = ~Eth*Sex*Age*Lrn, lower = ~1),
    trace = FALSE)
dropterm(quine.sp, test = "F")
quine.3 <- update(quine.sp, . ~ . - Eth:Age:Lrn)
dropterm(quine.3, test = "F")
quine.4 <- update(quine.3, . ~ . - Eth:Age)
dropterm(quine.4, test = "F")
quine.5 <- update(quine.4, . ~ . - Age:Lrn)
dropterm(quine.5, test = "F")
	house.glm0 <- glm(Freq ~ Infl*Type*Cont + Sat, family=poisson,
data = housing)
house.glm1 <- update(house.glm0, . ~ . + Sat*(Infl+Type+Cont))
dropterm(house.glm1, test = "Chisq")

eagles

Foraging Ecology of Bald Eagles

Description

Knight and Skagen collected during a field study on the foraging behaviour of wintering Bald Eagles in Washington State, USA data concerning 160 attempts by one (pirating) Bald Eagle to steal a chum salmon from another (feeding) Bald Eagle.
Usage
eagles

Format

The eagles data frame has 8 rows and 5 columns.

y  Number of successful attempts.
n  Total number of attempts.
P  Size of pirating eagle (L = large, S = small).
A  Age of pirating eagle (I = immature, A = adult).
V  Size of victim eagle (L = large, S = small).

Source


References


Examples

eagles.glm <- glm(cbind(y, n - y) ~ P*A + V, data = eagles,
                     family = binomial)
dropterm(eagles.glm)
prof <- profile(eagles.glm)
plot(prof)
pairs(prof)

epil  Seizure Counts for Epileptics

Description

Thall and Vail (1990) give a data set on two-week seizure counts for 59 epileptics. The number of seizures was recorded for a baseline period of 8 weeks, and then patients were randomly assigned to a treatment group or a control group. Counts were then recorded for four successive two-week periods. The subject’s age is the only covariate.

Usage

epil
Format

This data frame has 236 rows and the following 9 columns:

- `y` the count for the 2-week period.
- `trt` treatment, "placebo" or "progabide".
- `base` the counts in the baseline 8-week period.
- `age` subject's age, in years.
- `V4` 0/1 indicator variable of period 4.
- `subject` subject number, 1 to 59.
- `period` period, 1 to 4.
- `lbase` log-counts for the baseline period, centred to have zero mean.
- `lage` log-ages, centred to have zero mean.

Source


References


Examples

```r
summary(glm(y ~ lbase*trt + lage + V4, family = poisson, 
   data = epil), cor = FALSE)
epil2 <- epil[epil$period == 1, ]
epil2["period"] <- rep(0, 59); epil2["y"] <- epil2["base"]
epil["time"] <- 1; epil2["time"] <- 4
epil2 <- rbind(epil, epil2)
epil2$pred <- unclass(epil2$trt) * (epil2$period > 0)
epil2$subject <- factor(epil2$subject)
epil3 <- aggregate(epil2, list(epil2$subject, epil2$period > 0), 
   function(x) if(is.numeric(x)) sum(x) else x[1])
epil3$pred <- factor(epil3$pred, 
   labels = c("base", "placebo", "drug"))
contrasts(epil3$pred) <- structure(contr.sdif(3), 
   dimnames = list(NULL, c("placebo-base", "drug-placebo"))
summary(glm(y ~ pred + factor(subject) + offset(log(time)), 
   family = poisson, data = epil3), cor = FALSE)
summary(glmmPQL(y ~ lbase*trt + lage + V4, 
   random = ~ 1 | subject, 
   family = poisson, data = epil))
summary(glmmPQL(y ~ pred, random = ~1 | subject, 
   family = poisson, data = epil3))
```
Plots with Geometrically Equal Scales

Description

Version of a scatterplot with scales chosen to be equal on both axes, that is 1cm represents the same
units on each

Usage

eqscplot(x, y, ratio = 1, tol = 0.04, uin, ...)

Arguments

x  vector of x values, or a 2-column matrix, or a list with components x and y
y  vector of y values
ratio desired ratio of units on the axes. Units on the y axis are drawn at ratio times
the size of units on the x axis. Ignored if uin is specified and of length 2.
tol proportion of white space at the margins of plot
uin desired values for the units-per-inch parameter. If of length 1, the desired units
per inch on the x axis.
... further arguments for plot and graphical parameters. Note that par(xaxs="i", yaxs="i")
is enforced, and xlim and ylim will be adjusted accordingly.

Details

Limits for the x and y axes are chosen so that they include the data. One of the sets of limits is then
stretched from the midpoint to make the units in the ratio given by ratio. Finally both are stretched
by 1 + tol to move points away from the axes, and the points plotted.

Value

invisibly, the values of uin used for the plot.

Side Effects

performs the plot.

Note

Arguments ratio and uin were suggested by Bill Dunlap.

References

farms

See Also

plot, par

---

**farms**  
*Ecological Factors in Farm Management*

**Description**

The *farms* data frame has 20 rows and 4 columns. The rows are farms on the Dutch island of Terschelling and the columns are factors describing the management of grassland.

**Usage**

`farms`

**Format**

This data frame contains the following columns:

- **mois** Five levels of soil moisture – level 3 does not occur at these 20 farms.
- **manag** Grassland management type (SF = standard, BF = biological, HF = hobby farming, NM = nature conservation).
- **use** Grassland use (U1 = hay production, U2 = intermediate, U3 = grazing).
- **manure** Manure usage – classes C0 to C4.

**Source**


Quoted as from:


**References**


**Examples**

```r
farms.mca <- mca(farms, abbrev = TRUE)  # Use levels as names
eqscplot(farms.mca$cs, type = "n")
text(farms.mca$rs, cex = 0.7)
text(farms.mca$cs, labels = dimnames(farms.mca$cs)[[1]], cex = 0.7)
```
Description

The `fgl` data frame has 214 rows and 10 columns. It was collected by B. German on fragments of glass collected in forensic work.

Usage

`fgl`

Format

This data frame contains the following columns:

RI  refractive index; more precisely the refractive index is 1.518xxxx.

The next 8 measurements are percentages by weight of oxides.

Na  sodium.
Mg  manganese.
Al  aluminium.
Si  silicon.
K   potassium.
Ca  calcium.
Ba  barium.
Fe  iron.

`type` The fragments were originally classed into seven types, one of which was absent in this dataset. The categories which occur are window float glass (`Winf`: 70), window non-float glass (`WinnF`: 76), vehicle window glass (`Veh`: 17), containers (`Con`: 13), tableware (`Tabl`: 9) and vehicle headlamps (`Head`: 29).

References

Maximum-likelihood Fitting of Univariate Distributions

Description

Maximum-likelihood fitting of univariate distributions, allowing parameters to be held fixed if desired.

Usage

fitdistr(x, densfun, start, ...)

Arguments

x
A numeric vector of length at least one containing only finite values.
densfun
Either a character string or a function returning a density evaluated at its first argument.

Distributions "beta", "cauchy", "chi-squared", "exponential", "gamma", "geometric", "log-normal", "logistic", "negative binomial", "normal", "Poisson", "t" and "weibull" are recognised, case being ignored.

start
A named list giving the parameters to be optimized with initial values. This can be omitted for some of the named distributions and must be for others (see Details).

... Additional parameters, either for densfun or for optim. In particular, it can be used to specify bounds via lower or upper or both. If arguments of densfun (or the density function corresponding to a character-string specification) are included they will be held fixed.

Details

For the Normal, log-Normal, geometric, exponential and Poisson distributions the closed-form MLEs (and exact standard errors) are used, and start should not be supplied.

For all other distributions, direct optimization of the log-likelihood is performed using optim. The estimated standard errors are taken from the observed information matrix, calculated by a numerical approximation. For one-dimensional problems the Nelder-Mead method is used and for multi-dimensional problems the BFGS method, unless arguments named lower or upper are supplied (when L-BFGS-B is used) or method is supplied explicitly.

For the "t" named distribution the density is taken to be the location-scale family with location m and scale s.

For the following named distributions, reasonable starting values will be computed if start is omitted or only partially specified: "cauchy", "gamma", "logistic", "negative binomial" (parametrized by mu and size), "t" and "weibull". Note that these starting values may not be good enough if the fit is poor: in particular they are not resistant to outliers unless the fitted distribution is long-tailed.

There are print, coef, vcov and logLik methods for class "fitdistr".
Value

An object of class "fitdistr", a list with four components,

- `estimate` the parameter estimates,
- `sd` the estimated standard errors,
- `vcov` the estimated variance-covariance matrix, and
- `loglik` the log-likelihood.

Note

Numerical optimization cannot work miracles: please note the comments in `optim` on scaling data. If the fitted parameters are far away from one, consider re-fitting specifying the control parameter `parscale`.

References


Examples

```r
## avoid spurious accuracy
op <- options(digits = 3)
set.seed(123)
x <- rgamma(100, shape = 5, rate = 0.1)
fitdistr(x, "gamma")
## now do this directly with more control.
fitdistr(x, dgamma, list(shape = 1, rate = 0.1), lower = 0.001)

set.seed(123)
x2 <- rt(250, df = 9)
fitdistr(x2, "t", df = 9)
## allow df to vary: not a very good idea!
fitdistr(x2, "t")
## now do fixed-df fit directly with more control.
mydt <- function(x, m, s, df) dt((x-m)/s, df)/
fitdistr(x2, mydt, list(m = 0, s = 1), df = 9, lower = c(-Inf, 0))

set.seed(123)
x3 <- rweibull(100, shape = 4, scale = 100)
fitdistr(x3, "weibull")

set.seed(123)
x4 <- rnegbin(500, mu = 5, theta = 4)
fitdistr(x4, "Negative Binomial")
options(op)
```
forbes

Forbes' Data on Boiling Points in the Alps

Description
A data frame with 17 observations on boiling point of water and barometric pressure in inches of mercury.

Usage
forbes

Format
bp  boiling point (degrees Fahrenheit).
pres  barometric pressure in inches of mercury.

Source

fractions

Rational Approximation

Description
Find rational approximations to the components of a real numeric object using a standard continued fraction method.

Usage
fractions(x, cycles = 10, max.denominator = 2000, ...)

Arguments
x  Any object of mode numeric. Missing values are now allowed.
cycles  The maximum number of steps to be used in the continued fraction approximation process.
max.denominator  An early termination criterion. If any partial denominator exceeds max.denominator the continued fraction stops at that point.
...  arguments passed to or from other methods.
Details

Each component is first expanded in a continued fraction of the form

\[ x = \text{floor}(x) + 1/(p_1 + 1/(p_2 + \ldots)) \]

where \( p_1, p_2, \ldots \) are positive integers, terminating either at cycles terms or when a \( p_j \) > max. denominator. The continued fraction is then re-arranged to retrieve the numerator and denominator as integers.

The numerators and denominators are then combined into a character vector that becomes the “fracs” attribute and used in printed representations.

Arithmetic operations on "fractions" objects have full floating point accuracy, but the character representation printed out may not.

Value

An object of class "fractions". A structure with .Data component the same as the input numeric \( x \), but with the rational approximations held as a character vector attribute, "fracs". Arithmetic operations on "fractions" objects are possible.

References


See Also

rational

Examples

\[
X \leftarrow \text{matrix} \left( \text{runif}(25), 5, 5 \right)
\]
\[
zapsmall(\text{solve}(X, X/5)) \quad \# \text{print near-zeroes as zero}
\]
\[
\text{fractions}(\text{solve}(X, X/5))
\]
\[
\text{fractions}(\text{solve}(X, X/5)) + 1
\]
galaxies

Format

This data frame contains the following columns:

Age  age of child in years.
GAG  concentration of GAG (the units have been lost).

Source

Mrs Susan Prosser, Paediatrics Department, University of Oxford, via Department of Statistics Consulting Service.

References


---

galaxies

Velocities for 82 Galaxies

Description

A numeric vector of velocities in km/sec of 82 galaxies from 6 well-separated conic sections of an unfilled survey of the Corona Borealis region. Multimodality in such surveys is evidence for voids and superclusters in the far universe.

Usage

galaxies

Note

There is an 83rd measurement of 5607 km/sec in the Postman et al. paper which is omitted in Roeder (1990) and from the dataset here.

There is also a typo: this dataset has 78th observation 26690 which should be 26960.

Source


References

Examples

gal <- galaxies/1000
c(width.SJ(gal, method = "dpi"), width.SJ(gal))
plot(x = c(0, 40), y = c(0, 0.3), type = "n", bty = "l",
     xlab = "velocity of galaxy (1000km/s)", ylab = "density")
rug(gal)
lines(density(gal, width = 3.25, n = 200), lty = 1)
lines(density(gal, width = 2.56, n = 200), lty = 3)

Description

A front end to gamma.shape for convenience. Finds the reciprocal of the estimate of the shape parameter only.

Usage

gamma.dispersion(object, ...)

Arguments

object Fitted model object giving the gamma fit.
... Additional arguments passed on to gamma.shape.

Value

The MLE of the dispersion parameter of the gamma distribution.

References


See Also

gamma.shape.glm, including the example on its help page.
**Description**

Find the maximum likelihood estimate of the shape parameter of the gamma distribution after fitting a Gamma generalized linear model.

**Usage**

```r
## S3 method for class 'glm'
gamma.shape(object, it.lim = 10,
             eps.max = .Machine$double.eps^0.25, verbose = FALSE, ...)
```

**Arguments**

- `object`: Fitted model object from a Gamma family or quasi family with variance = "mu^2".
- `it.lim`: Upper limit on the number of iterations.
- `eps.max`: Maximum discrepancy between approximations for the iteration process to continue.
- `verbose`: If TRUE, causes successive iterations to be printed out. The initial estimate is taken from the deviance.
- `...`: Further arguments passed to or from other methods.

**Details**

A glm fit for a Gamma family correctly calculates the maximum likelihood estimate of the mean parameters but provides only a crude estimate of the dispersion parameter. This function takes the results of the glm fit and solves the maximum likelihood equation for the reciprocal of the dispersion parameter, which is usually called the shape (or exponent) parameter.

**Value**

List of two components

- `alpha`: the maximum likelihood estimate
- `SE`: the approximate standard error, the square-root of the reciprocal of the observed information.

**References**


**See Also**

`gamma.dispersion`
Examples

clotting <- data.frame(
  u = c(5,10,15,20,30,40,60,80,100),
  lot1 = c(118,58,42,35,27,25,21,19,18),
  lot2 = c(69,35,26,21,18,16,13,12,12))
clot1 <- glm(lot1 ~ log(u), data = clotting, family = Gamma)
gamma.shape(clot1)

gm <- glm(Days + 0.1 ~ Age*Eth*Sex*Lrn,
  quasi(link=log, variance="mu^2"), quine,
  start = c(3, rep(0,31)))
gamma.shape(gm, verbose = TRUE)
summary(gm, dispersion = gamma.dispersion(gm)) # better summary

---

**Remission Times of Leukaemia Patients**

Description

A data frame from a trial of 42 leukaemia patients. Some were treated with the drug 6-mercaptopurine and the rest are controls. The trial was designed as matched pairs, both withdrawn from the trial when either came out of remission.

Usage

gehan

Format

This data frame contains the following columns:

- **pair**: label for pair.
- **time**: remission time in weeks.
- **cens**: censoring, 0/1.
- **treat**: treatment, control or 6-MP.

Source


References

### Examples

```r
library(survival)
gehan.surv <- survfit(Surv(time, cens) ~ treat, data = gehan,
                      conf.type = "log-log")
summary(gehan.surv)
survreg(Surv(time, cens) ~ factor(pair) + treat, gehan, dist = "exponential")
summary(survreg(Surv(time, cens) ~ treat, gehan, dist = "exponential"))
survreg(Surv(time, cens) ~ treat, gehan)
gehan.cox <- coxph(Surv(time, cens) ~ treat, gehan)
summary(gehan.cox)
```

---

### genotype

#### Rat Genotype Data

**Description**

Data from a foster feeding experiment with rat mothers and litters of four different genotypes: A, B, I and J. Rat litters were separated from their natural mothers at birth and given to foster mothers to rear.

**Usage**

```r
genotype
```

**Format**

The data frame has the following components:

- **Litter** genotype of the litter.
- **Mother** genotype of the foster mother.
- **Wt** Litter average weight gain of the litter, in grams at age 28 days. (The source states that the within-litter variability is negligible.)

**Source**


**References**

**geyser**  
*Old Faithful Geyser Data*

**Description**

A version of the eruptions data from the ‘Old Faithful’ geyser in Yellowstone National Park, Wyoming. This version comes from Azzalini and Bowman (1990) and is of continuous measurement from August 1 to August 15, 1985.

Some nocturnal duration measurements were coded as 2, 3 or 4 minutes, having originally been described as ‘short’, ‘medium’ or ‘long’.

**Usage**

`geyser`

**Format**

A data frame with 299 observations on 2 variables.

<table>
<thead>
<tr>
<th>duration</th>
<th>numeric</th>
<th>Eruption time in mins</th>
</tr>
</thead>
<tbody>
<tr>
<td>waiting</td>
<td>numeric</td>
<td>Waiting time for this eruption</td>
</tr>
</tbody>
</table>

**Note**

The `waiting` time was incorrectly described as the time to the next eruption in the original files, and corrected for MASS version 7.3-30.

**References**


**See Also**

`faithful`.

CRAN package `sm`.

---

**gilgais**  
*Line Transect of Soil in Gilgai Territory*
Description

This dataset was collected on a line transect survey in gilgai territory in New South Wales, Australia. Gilgais are natural gentle depressions in otherwise flat land, and sometimes seem to be regularly distributed. The data collection was stimulated by the question: are these patterns reflected in soil properties? At each of 365 sampling locations on a linear grid of 4 meters spacing, samples were taken at depths 0-10 cm, 30-40 cm and 80-90 cm below the surface. pH, electrical conductivity and chloride content were measured on a 1:5 soil:water extract from each sample.

Usage

gilgais

Format

This data frame contains the following columns:

- $\text{pH}_{00}$  pH at depth 0–10 cm.
- $\text{pH}_{30}$  pH at depth 30–40 cm.
- $\text{pH}_{80}$  pH at depth 80–90 cm.
- $\text{e}_0$  electrical conductivity in mS/cm (0–10 cm).
- $\text{e}_3$  electrical conductivity in mS/cm (30–40 cm).
- $\text{e}_8$  electrical conductivity in mS/cm (80–90 cm).
- $\text{c}_0$  chloride content in ppm (0–10 cm).
- $\text{c}_3$  chloride content in ppm (30–40 cm).
- $\text{c}_8$  chloride content in ppm (80–90 cm).

Source


References

**ginv**

*Generalized Inverse of a Matrix*

**Description**

Calculates the Moore-Penrose generalized inverse of a matrix \(X\).

**Usage**

\[
\text{ginv}(X, \text{tol} = \sqrt{\text{Machine}\$\text{double}\$.eps})
\]

**Arguments**

- \(X\)  
  Matrix for which the Moore-Penrose inverse is required.
- \(\text{tol}\)  
  A relative tolerance to detect zero singular values.

**Value**

A MP generalized inverse matrix for \(X\).

**References**


**See Also**

`solve`, `svd`, `eigen`

**Examples**

```r
## Not run:
# The function is currently defined as
function(X, tol = sqrt(.Machine$double.eps))
{
  ## Generalized Inverse of a Matrix
dnx <- dimnames(X)
  if(is.null(dnx)) dnx <- vector("list", 2)
s <- svd(X)
nz <- s$d > tol * s$d[1]
  structure(
    if(any(nz)) s$v[, nz] %*% (t(s$u[, nz])/s$d[nz]) else X,
    dimnames = dnx[2:1])

## End(Not run)
```
glm.convert

Change a Negative Binomial fit to a GLM fit

Description

This function modifies an output object from glm.nb() to one that looks like the output from glm() with a negative binomial family. This allows it to be updated keeping the theta parameter fixed.

Usage

glm.convert(object)

Arguments

object An object of class "negbin", typically the output from glm.nb().

Details

Convenience function needed to effect some low level changes to the structure of the fitted model object.

Value

An object of class "glm" with negative binomial family. The theta parameter is then fixed at its present estimate.

See Also

glm.nb, negative.binomial, glm

Examples

quine.nb1 <- glm.nb(Days ~ Sex/(Age + Eth*Lrn), data = quine)
quine.nbA <- glm.convert(quine.nb1)
quine.nbB <- update(quine.nb1, . ~ . + Sex:Age:Lrn)
anova(quine.nbA, quine.nbB)
Fit a Negative Binomial Generalized Linear Model

Description

A modification of the system function \texttt{glm()} to include estimation of the additional parameter, theta, for a Negative Binomial generalized linear model.

Usage

\begin{verbatim}
glm.nb(formula, data, weights, subset, na.action,
      start = NULL, etastart, mustart,
      control = glm.control(...), method = "glm.fit",
      model = TRUE, x = FALSE, y = TRUE, contrasts = NULL, ...
      init.theta, link = log)
\end{verbatim}

Arguments

- \texttt{formula}, \texttt{data}, \texttt{weights}, \texttt{subset}, \texttt{na.action}, \texttt{start}, \texttt{etastart}, \texttt{mustart}, \texttt{control}, \texttt{method}, \texttt{model}, \texttt{x}, \texttt{y}, \texttt{contrasts} arguments for the \texttt{glm()} function. Note that these exclude \texttt{family} and \texttt{offset} (but \texttt{offset()} can be used).

- \texttt{init.theta} Optional initial value for the theta parameter. If omitted a moment estimator after an initial fit using a Poisson GLM is used.

- \texttt{link} The link function. Currently must be one of log, sqrt or identity.

Details

An alternating iteration process is used. For given theta the GLM is fitted using the same process as used by \texttt{glm()}. For fixed means the theta parameter is estimated using score and information iterations. The two are alternated until convergence of both. (The number of alternations and the number of iterations when estimating theta are controlled by the \texttt{maxit} parameter of \texttt{glm.control}.)

Setting \texttt{trace > 0} traces the alternating iteration process. Setting \texttt{trace > 1} traces the \texttt{glm.fit}, and setting \texttt{trace > 2} traces the estimation of theta.

Value

A fitted model object of class \texttt{negbin} inheriting from \texttt{glm} and \texttt{lm}. The object is like the output of \texttt{glm} but contains three additional components, namely \texttt{theta} for the ML estimate of theta, \texttt{SE.theta} for its approximate standard error (using observed rather than expected information), and \texttt{twologlik} for twice the log-likelihood function.

References

See Also

`glm, negative.binomial, anova.negbin, summary.negbin, theta.md`

There is a `simulate` method.

Examples

```r
quine.nb1 <- glm.nb(Days ~ Sex/(Age + Eth*Lrn), data = quine)
quine.nb2 <- update(quine.nb1, . ~ . + Sex:Age:Lrn)
quine.nb3 <- update(quine.nb2, Days ~ .^4)
anova(quine.nb1, quine.nb2, quine.nb3)
```

---

**glmmPQL**

*Fit Generalized Linear Mixed Models via PQL*

**Description**

Fit a GLMM model with multivariate normal random effects, using Penalized Quasi-Likelihood.

**Usage**

```r
glmmPQL(fixed, random, family, data, correlation, weights,
        control, niter = 10, verbose = TRUE, ...)
```

**Arguments**

- `fixed`: a two-sided linear formula giving fixed-effects part of the model.
- `random`: a formula or list of formulae describing the random effects.
- `family`: a GLM family.
- `data`: an optional data frame used as the first place to find variables in the formulae, weights and if present in ..., subset.
- `correlation`: an optional correlation structure.
- `weights`: optional case weights as in `glm`.
- `control`: an optional argument to be passed to `lme`.
- `niter`: maximum number of iterations.
- `verbose`: logical: print out record of iterations?
- `...`: Further arguments for `lme`.

**Details**

`glmmPQL` works by repeated calls to `lme`, so package `nlme` will be loaded at first use if necessary.

**Value**

A object of class "lme": see `lmeObject`.

References


See Also

lme

Examples

```r
library(nlme) # will be loaded automatically if omitted
summary(glmmPQL(y ~ trt + I(week > 2), random = ~ 1 | ID,
              family = binomial, data = bacteria))
```

The record times in 1984 for 35 Scottish hill races.

Usage

hills

Format

The components are:

- **dist**: distance in miles (on the map).
- **climb**: total height gained during the route, in feet.
- **time**: record time in minutes.

Source


[A.C. Atkinson (1988) Transformations unmasked. *Technometrics* **30**, 311–318 “corrects” the time for Knock Hill from 78.65 to 18.65. It is unclear if this based on the original records.]

References

**hist.scott**  
*Plot a Histogram with Automatic Bin Width Selection*

**Description**

Plot a histogram with automatic bin width selection, using the Scott or Freedman–Diaconis formulae.

**Usage**

```r
hist.scott(x, prob = TRUE, xlab = deparse(substitute(x)), ...)
hist.FD(x, prob = TRUE, xlab = deparse(substitute(x)), ...)
```

**Arguments**

- `x` A data vector
- `prob` Should the plot have unit area, so be a density estimate?
- `xlab`, `...` Further arguments to `hist`.

**Value**

For the `nclass.*` functions, the suggested number of classes.

**Side Effects**

Plot a histogram.

**References**


**See Also**

- `hist`

---

**housing**  
*Frequency Table from a Copenhagen Housing Conditions Survey*

**Description**

The `housing` data frame has 72 rows and 5 variables.

**Usage**

```r
housing
```
Format

Sat  Satisfaction of householders with their present housing circumstances, (High, Medium or Low, ordered factor).

Inf1  Perceived degree of influence householders have on the management of the property (High, Medium, Low).

Type  Type of rental accommodation, (Tower, Atrium, Apartment, Terrace).

Cont  Contact residents are afforded with other residents, (Low, High).

Freq  Frequencies: the numbers of residents in each class.

Source


References


Examples

options(contrasts = c("contr.treatment", "contr.poly"))

# Surrogate Poisson models
house.glm0 <- glm(Freq ~ Infl*Type*Cont + Sat, family = poisson,
                   data = housing)
summary(house.glm0, cor = FALSE)

addterm(house.glm0, ~. + Sat:(Infl+Type+Cont), test = "Chisq")

house.glm1 <- update(house.glm0, ~. + Sat*(Infl+Type+Cont))
summary(house.glm1, cor = FALSE)

1 - pchisq(deviance(house.glm1), house.glm1$df.residual)

dropterm(house.glm1, test = "Chisq")

addterm(house.glm1, ~. + Sat:(Infl+Type+Cont)^2, test = "Chisq")

hnames <- lapply(housing[, -5], levels) # omit Freq
newData <- expand.grid(hnames)
newData$Sat <- ordered(newData$Sat)
house.pm <- predict(house.glm1, newData,
                     type = "response") # poisson means
house.pm <- matrix(house.pm, ncol = 3, byrow = TRUE,
                    dimnames = list(NULL, hnames[[1]]))
house.pr <- house.pm/drop(house.pm %*% rep(1, 3))
cbind(expand.grid(hnames[-1]), round(house.pr, 2))
# Iterative proportional scaling
loglm(Freq ~ Infl*Type*Cont + Sat*(Infl+Type+Cont), data = housing)

# multinom model
library(nnet)
(house.mult<- multinom(Sat ~ Infl + Type + Cont, weights = Freq, data = housing))
house.mult2 <- multinom(Sat ~ Infl*Type*Cont, weights = Freq, data = housing)
anova(house.mult, house.mult2)

house.pm <- predict(house.mult, expand.grid(hnames[-1]), type = "probs")
cbind(expand.grid(hnames[-1]), round(house.pm, 2))

# proportional odds model
house.cpr <- apply(house.pr, 1, cumsum)
logit <- function(x) log(x/(1-x))
house.ld <- logit(house.cpr[2, ] - logit(house.cpr[1, ])
(ratio <- sort(drop(house.ld)))
mean(ratio)

(house.plr <- polr(Sat ~ Infl + Type + Cont, data = housing, weights = Freq))

house.pr1 <- predict(house.plr, expand.grid(hnames[-1]), type = "probs")
cbind(expand.grid(hnames[-1]), round(house.pr1, 2))

Fr <- matrix(housing$Freq, ncol = 3, byrow = TRUE)
2*sum(Fr*log(house.pr/house.pr1))

house.plr2 <- stepAIC(house.plr, ~.^2)
house.plr2$anova

huber

\textit{Huber M-estimator of Location with MAD Scale}

\textbf{Description}

Finds the Huber M-estimator of location with MAD scale.

\textbf{Usage}

\texttt{huber(y, k = 1.5, tol = 1e-06)}

\textbf{Arguments}

\begin{itemize}
  \item \texttt{y} \hspace{1cm} vector of data values
  \item \texttt{k} \hspace{1cm} Winsorizes at k standard deviations
  \item \texttt{tol} \hspace{1cm} convergence tolerance
\end{itemize}
Value

list of location and scale parameters

mu location estimate
s MAD scale estimate

References


See Also

hubers, mad

Examples

huber(chem)

hubers

Huber Proposal 2 Robust Estimator of Location and/or Scale

Description

Finds the Huber M-estimator for location with scale specified, scale with location specified, or both if neither is specified.

Usage

hubers(y, k = 1.5, mu, s, initmu = median(y), tol = 1e-06)

Arguments

y vector of data values
k Winsorizes at k standard deviations
mu specified location
s specified scale
initmu initial value of mu
tol convergence tolerance

Value

list of location and scale estimates

mu location estimate
s scale estimate
References


See Also

huber

Examples

```r
hubers(chem)
hubers(chem, mu=3.68)
```

---

Yields from a Barley Field Trial

Description

The *immer* data frame has 30 rows and 4 columns. Five varieties of barley were grown in six locations in each of 1931 and 1932.

Usage

immer

Format

This data frame contains the following columns:

- `loc` The location.
- `var` The variety of barley ("manchuria", "svansota", "velvet", "trebi" and "peatland").
- `y1` Yield in 1931.
- `y2` Yield in 1932.

Source


References

Examples

```r
immer.aov <- aov(cbind(Y1,Y2) ~ Loc + Var, data = immer)
summary(immer.aov)

immer.aov <- aov((Y1+Y2)/2 ~ Var + Loc, data = immer)
summary(immer.aov)
model.tables(immer.aov, type = "means", se = TRUE, cterms = "Var")
```

<table>
<thead>
<tr>
<th>Insurance</th>
<th>Numbers of Car Insurance claims</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Description

The data given in data frame `insurance` consist of the numbers of policyholders of an insurance company who were exposed to risk, and the numbers of car insurance claims made by those policyholders in the third quarter of 1973.

Usage

`insurance`

Format

This data frame contains the following columns:

- `district`: factor: district of residence of policyholder (1 to 4): 4 is major cities.
- `group`: an ordered factor: group of car with levels <1 litre, 1–1.5 litre, 1.5–2 litre, >2 litre.
- `holders`: numbers of policyholders.
- `claims`: numbers of claims

Source


References

isoMDS

Examples

```r
## main-effects fit as Poisson GLM with offset
glm(Claims ~ District + Group + Age + offset(log(Holders)),
    data = Insurance, family = poisson)

# same via loglm
loglm(Claims ~ District + Group + Age + offset(log(Holders)),
      data = Insurance)
```

isoMDS

Kruskal’s Non-metric Multidimensional Scaling

Description

One form of non-metric multidimensional scaling

Usage

```r
isoMDS(d, y = cmdscale(d, k), k = 2, maxit = 50, trace = TRUE,
       tol = 1e-3, p = 2)
```

Shepard(d, x, p = 2)

Arguments

d distance structure of the form returned by `dist`, or a full, symmetric matrix. Data are assumed to be dissimilarities or relative distances, but must be positive except for self-distance. Both missing and infinite values are allowed.

y An initial configuration. If none is supplied, `cmdscale` is used to provide the classical solution, unless there are missing or infinite dissimilarities.

k The desired dimension for the solution, passed to `cmdscale`.

maxit The maximum number of iterations.

trace Logical for tracing optimization. Default `TRUE`.

tol Convergence tolerance.

p Power for Minkowski distance in the configuration space.

x A final configuration.

Details

This chooses a k-dimensional (default k = 2) configuration to minimize the stress, the square root of the ratio of the sum of squared differences between the input distances and those of the configuration to the sum of configuration distances squared. However, the input distances are allowed a monotonic transformation.

An iterative algorithm is used, which will usually converge in around 10 iterations. As this is necessarily an $O(n^2)$ calculation, it is slow for large datasets. Further, since for the default $p = 2$ the configuration is only determined up to rotations and reflections (by convention the centroid is at the origin), the result can vary considerably from machine to machine.
**Value**

Two components:

- **points**: A k-column vector of the fitted configuration.
- **stress**: The final stress achieved (in percent).

**Side Effects**

If `trace` is true, the initial stress and the current stress are printed out every 5 iterations.

**References**


**See Also**

`cmdscale`, `sammon`

**Examples**

```r
swiss.x <- as.matrix(swiss[, -1])
swiss.dist <- dist(swiss.x)
swiss.mds <- isoMDS(swiss.dist)
plot(swiss.mds$points, type = "n")
text(swiss.mds$points, labels = as.character(1:nrow(swiss.x)))
swiss.sh <- Shepard(swiss.dist, swiss.mds$points)
plot(swiss.sh, pch = ".")
lines(swiss.sh$x, swiss.sh$yf, type = "S")
```

---

**kde2d**

*Two-Dimensional Kernel Density Estimation*

**Description**

Two-dimensional kernel density estimation with an axis-aligned bivariate normal kernel, evaluated on a square grid.

**Usage**

```r
kde2d(x, y, h, n = 25, lims = c(range(x), range(y)))
```
Arguments

- **x**: x coordinate of data
- **y**: y coordinate of data
- **h**: vector of bandwidths for x and y directions. Defaults to normal reference bandwidth (see `bandwidth.nrd`). A scalar value will be taken to apply to both directions.
- **n**: Number of grid points in each direction. Can be scalar or a length-2 integer vector.
- **lims**: The limits of the rectangle covered by the grid as c(xL, xu, yL, yu).

Value

A list of three components.

- **x**, **y**: The x and y coordinates of the grid points, vectors of length n.

References


Examples

```r
attach(geyser)
plot(duration, waiting, xlim = c(0.5, 6), ylim = c(40, 100))
f1 <- kde2d(duration, waiting, n = 50, lims = c(0.5, 6, 40, 100))
image(f1, zlim = c(0, 0.05))
f2 <- kde2d(duration, waiting, n = 50, lims = c(0.5, 6, 40, 100),
          h = c(width.SJ(duration), width.SJ(waiting)))
image(f2, zlim = c(0, 0.05))
persp(f2, phi = 30, theta = 20, d = 5)

plot(duration[-272], duration[-1], xlim = c(0.5, 6),
     ylim = c(11, 6), xlab = "previous duration", ylab = "duration")
f1 <- kde2d(duration[-272], duration[-1],
            h = rep(1.5, 2), n = 50, lims = c(0.5, 6, 0.5, 6))
contour(f1, xlab = "previous duration",
        ylab = "duration", levels = c(0.05, 0.1, 0.2, 0.4))
f1 <- kde2d(duration[-272], duration[-1],
            h = rep(0.6, 2), n = 50, lims = c(0.5, 6, 0.5, 6))
contour(f1, xlab = "previous duration",
        ylab = "duration", levels = c(0.05, 0.1, 0.2, 0.4))
f1 <- kde2d(duration[-272], duration[-1],
            h = rep(0.4, 2), n = 50, lims = c(0.5, 6, 0.5, 6))
contour(f1, xlab = "previous duration",
        ylab = "duration", levels = c(0.05, 0.1, 0.2, 0.4))
detach("geyser")
```
**Description**

Linear discriminant analysis.

**Usage**

```r
lda(x, ...)  
## S3 method for class 'formula'
lda(formula, data, ..., subset, na.action)

## Default S3 method:
lda(x, grouping, prior = proportions, tol = 1.0e-4,
    method, CV = FALSE, nu, ...)

## S3 method for class 'data.frame'
lda(x, ...)

## S3 method for class 'matrix'
lda(x, grouping, ..., subset, na.action)
```

**Arguments**

- `formula`: A formula of the form `groups ~ x1 + x2 + ...`. That is, the response is the grouping factor and the right hand side specifies the (non-factor) discriminators.
- `data`: Data frame from which variables specified in `formula` are preferentially to be taken.
- `x`: (required if no formula is given as the principal argument.) a matrix or data frame or Matrix containing the explanatory variables.
- `grouping`: (required if no formula principal argument is given.) a factor specifying the class for each observation.
- `prior`: the prior probabilities of class membership. If unspecified, the class proportions for the training set are used. If present, the probabilities should be specified in the order of the factor levels.
- `tol`: A tolerance to decide if a matrix is singular; it will reject variables and linear combinations of unit-variance variables whose variance is less than `tol^2`.
- `subset`: An index vector specifying the cases to be used in the training sample. (NOTE: If given, this argument must be named.)
- `na.action`: A function to specify the action to be taken if NAs are found. The default action is for the procedure to fail. An alternative is `na.omit`, which leads to rejection of cases with missing values on any required variable. (NOTE: If given, this argument must be named.)
method
  "moment" for standard estimators of the mean and variance, "mle" for MLEs, "mve" to use cov.mve, or "t" for robust estimates based on a t distribution.

CV
  If true, returns results (classes and posterior probabilities) for leave-one-out cross-validation. Note that if the prior is estimated, the proportions in the whole dataset are used.

nu
degrees of freedom for method = "t".

...arguments passed to or from other methods.

Details

The function tries hard to detect if the within-class covariance matrix is singular. If any variable has within-group variance less than 10^{-2} it will stop and report the variable as constant. This could result from poor scaling of the problem, but is more likely to result from constant variables.

Specifying the prior will affect the classification unless over-ridden in predict.lda. Unlike in most statistical packages, it will also affect the rotation of the linear discriminants within their space, as a weighted between-groups covariance matrix is used. Thus the first few linear discriminants emphasize the differences between groups with the weights given by the prior, which may differ from their prevalence in the dataset.

If one or more groups is missing in the supplied data, they are dropped with a warning, but the classifications produced are with respect to the original set of levels.

Value

If CV = TRUE the return value is a list with components class, the MAP classification (a factor), and posterior, posterior probabilities for the classes.

Otherwise it is an object of class "lda" containing the following components:

prior
  the prior probabilities used.

means
  the group means.

scaling
  a matrix which transforms observations to discriminant functions, normalized so that within groups covariance matrix is spherical.

svd
  the singular values, which give the ratio of the between- and within-group standard deviations on the linear discriminant variables. Their squares are the canonical F-statistics.

N
  The number of observations used.

call
  The (matched) function call.

Note

This function may be called giving either a formula and optional data frame, or a matrix and grouping factor as the first two arguments. All other arguments are optional, but subset= and na.action=, if required, must be fully named.

If a formula is given as the principal argument the object may be modified using update() in the usual way.
ldahist

Histograms or Density Plots of Multiple Groups

Description

Plot histograms or density plots of data on a single Fisher linear discriminant.

Usage

```
ldahist(data, g, nbins = 25, h, x0 = - h/1000, breaks, 
        xlim = range(breaks), ymax = 0, width, 
        type = c("histogram", "density", "both"), 
        sep = (type != "density"), 
        col = 5, xlab = deparse(substitute(data)), bty = "n", ...)```

Arguments

data vector of data. Missing values (NAs) are allowed and omitted.
g factor or vector giving groups, of the same length as data.
nbins Suggested number of bins to cover the whole range of the data.
h The bin width (takes precedence over nbins).
x0 Shift for the bins - the breaks are at x0 + h * (..., -1, 0, 1, ...)
leuk

breaks  The set of breakpoints to be used. (Usually omitted, takes precedence over h and nbin).
xlim  The limits for the x-axis.
ymax  The upper limit for the y-axis.
width  Bandwidth for density estimates. If missing, the Sheather-Jones selector is used for each group separately.
type  Type of plot.
sep  Whether there is a separate plot for each group, or one combined plot.
col  The colour number for the bar fill.
xlab  label for the plot x-axis. By default, this will be the name of data.
bty  The box type for the plot - defaults to none.
...  additional arguments to polygon.

Side Effects

Histogram and/or density plots are plotted on the current device.

References


See Also

plot.lda.

---

leuk  Survival Times and White Blood Counts for Leukaemia Patients

Description

A data frame of data from 33 leukaemia patients.

Usage

leuk

Format

A data frame with columns:

wbc  white blood count.
ag  a test result, "present" or "absent".
time  survival time in weeks.
Details

Survival times are given for 33 patients who died from acute myelogenous leukaemia. Also measured was the patient’s white blood cell count at the time of diagnosis. The patients were also factored into 2 groups according to the presence or absence of a morphologic characteristic of white blood cells. Patients termed AG positive were identified by the presence of Auer rods and/or significant granulation of the leukaemic cells in the bone marrow at the time of diagnosis.

Source


Taken from


References


Examples

library(survival)
plot(survfit(Surv(time) ~ ag, data = leuk), lty = 2:3, col = 2:3)

# now Cox models
leuk.cox <- coxph(Surv(time) ~ ag + log(wbc), leuk)
summary(leuk.cox)

---

lm.gls

*Fit Linear Models by Generalized Least Squares*

Description

Fit linear models by Generalized Least Squares

Usage

`lm.gls(formula, data, W, subset, na.action, inverse = FALSE, method = "qr", model = FALSE, x = FALSE, y = FALSE, contrasts = NULL, ...)`

Arguments

- **formula**: a formula expression as for regression models, of the form `response ~ predictors`. See the documentation of `formula` for other details.
- **data**: an optional data frame in which to interpret the variables occurring in `formula`.
- **W**: a weight matrix.
lm.ridge

subset expression saying which subset of the rows of the data should be used in the fit. All observations are included by default.

na.action a function to filter missing data.

inverse logical: if true \( \mathbf{W} \) specifies the inverse of the weight matrix: this is appropriate if a variance matrix is used.

method method to be used by \texttt{lm.fit}.

model should the model frame be returned?

x should the design matrix be returned?

y should the response be returned?

contrasts a list of contrasts to be used for some or all of

... additional arguments to \texttt{lm.fit}.

Details

The problem is transformed to uncorrelated form and passed to \texttt{lm.fit}.

Value

An object of class "\texttt{lm.gls}" which is similar to an "\texttt{lm}" object. There is no "weights" component, and only a few "\texttt{lm}" methods will work correctly. As from version 7.1-22 the residuals and fitted values refer to the untransformed problem.

See Also

\texttt{gls}, \texttt{lm}, \texttt{lm.ridge}

---

\texttt{lm.ridge} \hspace{1cm} \textit{Ridge Regression}

Description

Fit a linear model by ridge regression.

Usage

\texttt{lm.ridge(formula, data, subset, na.action, lambda = 0, model = FALSE,}
\hspace{1.5cm} x = FALSE, y = FALSE, contrasts = NULL, ...)}
Arguments

- **formula**: a formula expression as for regression models, of the form `response ~ predictors`. See the documentation of `formula` for other details. **offset** terms are allowed.
- **data**: an optional data frame in which to interpret the variables occurring in `formula`.
- **subset**: expression saying which subset of the rows of the data should be used in the fit. All observations are included by default.
- **na.action**: a function to filter missing data.
- **lambda**: A scalar or vector of ridge constants.
- **model**: should the model frame be returned? Not implemented.
- **x**: should the design matrix be returned? Not implemented.
- **y**: should the response be returned? Not implemented.
- **contrasts**: a list of contrasts to be used for some or all of factor terms in the formula. See the contrasts.arg of `model.matrix.default`.
- **...**: additional arguments to `lm.fit`.

Details

If an intercept is present in the model, its coefficient is not penalized. (If you want to penalize an intercept, put in your own constant term and remove the intercept.)

Value

A list with components

- **coef**: matrix of coefficients, one row for each value of `lambda`. Note that these are not on the original scale and are for use by the `coef` method.
- **scales**: scalings used on the X matrix.
- **Inter**: was intercept included?
- **lambda**: vector of lambda values
- **ym**: mean of `y`
- **xm**: column means of `x` matrix
- **GCV**: vector of GCV values
- **kHKB**: HKB estimate of the ridge constant.
- **kLW**: L-W estimate of the ridge constant.

References


See Also

- `lm`
**Examples**

longley # not the same as the S-PLUS dataset
names(longley)[1] <- "y"
lm.ridge(y ~ ., longley)
plot(lm.ridge(y ~ ., longley,
    lambda = seq(0.01,0.001)))
select(lm.ridge(y ~ ., longley,
    lambda = seq(0.01,0.0001)))

---

**loglm**  
*Fit Log-Linear Models by Iterative Proportional Scaling*

**Description**

This function provides a front-end to the standard function, `loglin`, to allow log-linear models to be specified and fitted in a manner similar to that of other fitting functions, such as `glm`.

**Usage**

`loglm(formula, data, subset, na.action, ...)`

**Arguments**

- `formula`  
  A linear model formula specifying the log-linear model.  
  If the left-hand side is empty, the `data` argument is required and must be a (complete) array of frequencies. In this case the variables on the right-hand side may be the names of the `dimnames` attribute of the frequency array, or may be the positive integers: 1, 2, 3, ... used as alternative names for the 1st, 2nd, 3rd, ... dimension (classifying factor). If the left-hand side is not empty it specifies a vector of frequencies. In this case the `data` argument, if present, must be a data frame from which the left-hand side vector and the classifying factors on the right-hand side are (preferentially) obtained. The usual abbreviation of a . to stand for 'all other variables in the data frame' is allowed. Any non-factors on the right-hand side of the formula are coerced to factor.

- `data`  
  Numeric array or data frame. In the first case it specifies the array of frequencies; in the second it provides the data frame from which the variables occurring in the formula are preferentially obtained in the usual way.  
  This argument may be the result of a call to `xtabs`.

- `subset`  
  Specifies a subset of the rows in the data frame to be used. The default is to take all rows.

- `na.action`  
  Specifies a method for handling missing observations. The default is to fail if missing values are present.

- `...`  
  May supply other arguments to the function `loglm1`. 
Details

If the left-hand side of the formula is empty the data argument supplies the frequency array and the right-hand side of the formula is used to construct the list of fixed faces as required by \texttt{loglin}. Structural zeros may be specified by giving a \texttt{start} argument with those entries set to zero, as described in the help information for \texttt{loglin}.

If the left-hand side is not empty, all variables on the right-hand side are regarded as classifying factors and an array of frequencies is constructed. If some cells in the complete array are not specified they are treated as structural zeros. The right-hand side of the formula is again used to construct the list of faces on which the observed and fitted totals must agree, as required by \texttt{loglin}. Hence terms such as \texttt{a:b}, \texttt{a*b} and \texttt{a/b} are all equivalent.

Value

An object of class "\texttt{loglm}" conveying the results of the fitted log-linear model. Methods exist for the generic functions \texttt{print}, \texttt{summary}, \texttt{deviance}, \texttt{fitted}, \texttt{coef}, \texttt{resid}, \texttt{anova} and \texttt{update}, which perform the expected tasks. Only log-likelihood ratio tests are allowed using \texttt{anova}.

The deviance is simply an alternative name for the log-likelihood ratio statistic for testing the current model within a saturated model, in accordance with standard usage in generalized linear models.

Warning

If structural zeros are present, the calculation of degrees of freedom may not be correct. \texttt{loglin} itself takes no action to allow for structural zeros. \texttt{loglm} deducts one degree of freedom for each structural zero, but cannot make allowance for gains in error degrees of freedom due to loss of dimension in the model space. (This would require checking the rank of the model matrix, but since iterative proportional scaling methods are developed largely to avoid constructing the model matrix explicitly, the computation is at least difficult.)

When structural zeros (or zero fitted values) are present the estimated coefficients will not be available due to infinite estimates. The deviances will normally continue to be correct, though.

References


See Also

\texttt{loglm}, \texttt{loglin}

Examples

# The data frames Cars93, minn38 and quine are available # in the MASS package.

# Case 1: frequencies specified as an array.
sapply(minn38, function(x) length(levels(x))){}
## hs phs f01 sex f
## 3 4 7 2 0
##minn38a <- array(0, c(3,4,7,2), lapply(minn38[, -5], levels))
##minn38a[data.matrix(minn38[, -5])] <- minn38$f
## Description

Find and optionally plot the marginal (profile) likelihood for alpha for a transformation model of the form \( \log(y + \alpha) \sim x_1 + x_2 + \ldots \).

## Usage

```r
logtrans(object, ...)  
```

## Examples

```r
## or more simply
minn38a <- xtabs(f ~ ., minn38)

fm <- loglm(~ 1 + 2 + 3 + 4, minn38a)  # numerals as names.
device(fm)
## [1] 3711.9
fm1 <- update(fm, .~.^2)
fml2 <- update(fm, .~.^3, print = TRUE)
## 5 iterations: deviation 0.075
anova(fm, fm1, fm2)

# Case 1. An array generated with xtabs.

loglm(~ Type + Origin, xtabs(~ Type + Origin, Cars93))

# Case 2. Frequencies given as a vector in a data frame names(quine)

## [1] "Eth" "Sex" "Age" "Lrn" "Days"
fm <- loglm(Days ~ .^2, quine)
gm <- glm(Days ~ .^2, poisson, quine)  # check glm.
c(deviance(fm), deviance(gm))  # deviances agree
## [1] 1368.7 1368.7
c(fm$df, gm$df)  # resid df do not!
c(fm$df, gm$df.residual)  # resid df do not!
## [1] 127 128

# The loglm residual degrees of freedom is wrong because of
# a non-detectable redundancy in the model matrix.

---

### logtrans

**Estimate log Transformation Parameter**

#### Description

Find and optionally plot the marginal (profile) likelihood for alpha for a transformation model of the form \( \log(y + \alpha) \sim x_1 + x_2 + \ldots \).

#### Usage

```r
logtrans(object, ...)  
```

#### Examples

```r
## or more simply
minn38a <- xtabs(f ~ ., minn38)

fm <- loglm(~ 1 + 2 + 3 + 4, minn38a)  # numerals as names.
device(fm)
## [1] 3711.9
fm1 <- update(fm, .~.^2)
fml2 <- update(fm, .~.^3, print = TRUE)
## 5 iterations: deviation 0.075
anova(fm, fm1, fm2)

# Case 1. An array generated with xtabs.

loglm(~ Type + Origin, xtabs(~ Type + Origin, Cars93))

# Case 2. Frequencies given as a vector in a data frame names(quine)

## [1] "Eth" "Sex" "Age" "Lrn" "Days"
fm <- loglm(Days ~ .^2, quine)
gm <- glm(Days ~ .^2, poisson, quine)  # check glm.
c(deviance(fm), deviance(gm))  # deviances agree
## [1] 1368.7 1368.7
c(fm$df, gm$df)  # resid df do not!
c(fm$df, gm$df.residual)  # resid df do not!
## [1] 127 128

# The loglm residual degrees of freedom is wrong because of
# a non-detectable redundancy in the model matrix.
```
## S3 method for class 'lm'

`logtrans(object, ...)`

### Arguments

- **object**: Fitted linear model object, or formula defining the untransformed model that is `y ~ x1 + x2 + ...`. The function is generic.
- **...**: If `object` is a formula, this argument may specify a data frame as for `lm`.
- **alpha**: Set of values for the transformation parameter, alpha.
- **plotit**: Should plotting be done?
- **interp**: Should the marginal log-likelihood be interpolated with a spline approximation? (Default is `TRUE` if plotting is to be done and the number of real points is less than 100.)
- **xlab**: as for `plot`.
- **ylab**: as for `plot`.
- **data**: optional data argument for `lm` fit.

### Value

List with components `x` (for alpha) and `y` (for the marginal log-likelihood values).

### Side Effects

A plot of the marginal log-likelihood is produced, if requested, together with an approximate mle and 95% confidence interval.

### References


### See Also

- `boxcox`

### Examples

```r
logtrans(Days ~ Age*Sex*Eth*Lrn, data = quine,
    alpha = seq(0.75, 6.5, len=20))
```
Description

Fit a regression to the good points in the dataset, thereby achieving a regression estimator with a high breakdown point. lmsreg and ltsreg are compatibility wrappers.

Usage

lqs(x, ...)

```r
## S3 method for class 'formula'
lqs(formula, data, ..., method = c("lts", "lqs", "lms", "S","model.frame"),
    subset, na.action, model = TRUE,
    x.ret = FALSE, y.ret = FALSE, contrasts = NULL)

## Default S3 method:
lqs(x, y, intercept = TRUE, method = c("lts", "lqs", "lms", "S"),
    quantile, control = lqs.control(...), k0 = 1.548, seed, ...)

lmsreg(...)  
ltsreg(...)
```

Arguments

- `formula` a formula of the form y ~ x1 + x2 + ....
- `data` data frame from which variables specified in formula are preferentially to be taken.
- `subset` an index vector specifying the cases to be used in fitting. (NOTE: If given, this argument must be named exactly.)
- `na.action` function to specify the action to be taken if NAs are found. The default action is for the procedure to fail. Alternatives include `na.omit` and `na.exclude`, which lead to omission of cases with missing values on any required variable. (NOTE: If given, this argument must be named exactly.)
- `model, x.ret, y.ret` logical. If TRUE the model frame, the model matrix and the response are returned, respectively.
- `contrasts` an optional list. See the contrasts.arg of `model.matrix.default`.
- `x` a matrix or data frame containing the explanatory variables.
- `y` the response: a vector of length the number of rows of x.
- `intercept` should the model include an intercept?
method  the method to be used. \texttt{model.frame} returns the model frame: for the others see the Details section. Using \texttt{lmsreg} or \texttt{ltsreg} forces "lms" and "lts" respectively.

quantile  the quantile to be used: see Details. This is over-ridden if \texttt{method } = "lms".

control  additional control items: see Details.

k0  the cutoff / tuning constant used for \( \chi() \) and \( \psi() \) functions when \texttt{method } = "S", currently corresponding to Tukey’s ‘biweight’.

seed  the seed to be used for random sampling: see .Random.seed. The current value of .Random.seed will be preserved if it is set.

...  arguments to be passed to \texttt{lqs.default} or \texttt{lqs.control}, see control above and Details.

Details

Suppose there are \( n \) data points and \( p \) regressors, including any intercept.

The first three methods minimize some function of the sorted squared residuals. For methods "1qs" and "lms" is the quantile squared residual, and for "lts" it is the sum of the quantile smallest squared residuals. "1qs" and "lms" differ in the defaults for quantile, which are floor((\( n + p + 1 \)) / 2) and floor((\( n + 1 \)) / 2) respectively. For "lts" the default is floor(\( n / 2 \)) + floor((\( p + 1 \)) / 2).

The "S" estimation method solves for the scale \( s \) such that the average of a function chi of the residuals divided by \( s \) is equal to a given constant.

The control argument is a list with components

\begin{itemize}
  \item \texttt{psamp}: the size of each sample. Defaults to \( p \).
  \item \texttt{nsamp}: the number of samples or "best" (the default) or "exact" or "sample". If "sample" the number chosen is \( \min(5p, 3000) \), taken from Rousseeuw and Hubert (1997). If "best" exhaustive enumeration is done up to 5000 samples; if "exact" exhaustive enumeration will be attempted however many samples are needed.
  \item \texttt{adjust}: should the intercept be optimized for each sample? Defaults to \texttt{TRUE}.
\end{itemize}

Value

An object of class "1qs". This is a list with components

\begin{itemize}
  \item \texttt{crit}: the value of the criterion for the best solution found, in the case of \texttt{method} == "S" before IWLS refinement.
  \item \texttt{sing}: character. A message about the number of samples which resulted in singular fits.
  \item \texttt{coefficients}: of the fitted linear model
  \item \texttt{bestone}: the indices of those points fitted by the best sample found (prior to adjustment of the intercept, if requested).
  \item \texttt{fitted.values}: the fitted values.
  \item \texttt{residuals}: the residuals.
  \item \texttt{scale}: estimate(s) of the scale of the error. The first is based on the fit criterion. The second (not present for \texttt{method} == "S") is based on the variance of those residuals whose absolute value is less than 2.5 times the initial estimate.
\end{itemize}
Note

There seems no reason other than historical to use the lms and lqs options. LMS estimation is of low efficiency (converging at rate $n^{-1/3}$) whereas LTS has the same asymptotic efficiency as an M estimator with trimming at the quartiles (Marazzi, 1993, p.201). LQS and LTS have the same maximal breakdown value of $(\text{floor}(n-p)/2 + 1)/n$ attained if $\text{floor}((n+p)/2) \leq \text{quantile} \leq \text{floor}((n+p+1)/2)$. The only drawback mentioned of LTS is greater computation, as a sort was thought to be required (Marazzi, 1993, p.201) but this is not true as a partial sort can be used (and is used in this implementation).

Adjusting the intercept for each trial fit does need the residuals to be sorted, and may be significant extra computation if $n$ is large and $p$ small.

Opinions differ over the choice of $psamp$. Rousseeuw and Hubert (1997) only consider $p$; Marazzi (1993) recommends $p+1$ and suggests that more samples are better than adjustment for a given computational limit.

The computations are exact for a model with just an intercept and adjustment, and for LQS for a model with an intercept plus one regressor and exhaustive search with adjustment. For all other cases the minimization is only known to be approximate.

References


See Also

`predict.lqs`

Examples

```
set.seed(123) # make reproducible
lqs(stack.loss ~ ., data = stackloss)
lqs(stack.loss ~ ., data = stackloss, method = "S", nsamp = "exact")
```

mammals

*Brain and Body Weights for 62 Species of Land Mammals*

Description

A data frame with average brain and body weights for 62 species of land mammals.

Usage

`mammals`
Format

- **body**: body weight in kg.
- **brain**: brain weight in g.
- **name**: Common name of species. (Rock hyrax-a = *Heterohyrax brucci*, Rock hyrax-b = *Procavia habessinic*.)

Source


References


---

**mca**  
Multiple Correspondence Analysis

Description

Computes a multiple correspondence analysis of a set of factors.

Usage

```r
mca(df, nf = 2, abbrev = FALSE)
```

Arguments

- **df**: A data frame containing only factors
- **nf**: The number of dimensions for the MCA. Rarely 3 might be useful.
- **abbrev**: Should the vertex names be abbreviated? By default these are of the form ‘factor.level’ but if `abbrev = TRUE` they are just ‘level’ which will suffice if the factors have distinct levels.

Value

An object of class "mca", with components

- **rs**: The coordinates of the rows, in `nf` dimensions.
- **cs**: The coordinates of the column vertices, one for each level of each factor.
- **fs**: Weights for each row, used to interpolate additional factors in `predict.mca`.
- **p**: The number of factors
- **d**: The singular values for the `nf` dimensions.
- **call**: The matched call.
References


See Also

`predict.mca`, `plot.mca`, `corresp`

Examples

```r
farms.mca <- mca(farms, abbrev=TRUE)
farms.mca
plot(farms.mca)
```

DATA FRAME

### `mcycle`

*Data from a Simulated Motorcycle Accident*

Description

A data frame giving a series of measurements of head acceleration in a simulated motorcycle accident, used to test crash helmets.

Usage

```r
mcycle
```

Format

- `times` in milliseconds after impact.
- `accel` in g.

Source


References

Melanoma  

Description
The Melanoma data frame has data on 205 patients in Denmark with malignant melanoma.

Usage
Melanoma

Format
This data frame contains the following columns:
- time  survival time in days, possibly censored.
- status 1 died from melanoma, 2 alive, 3 dead from other causes.
- sex 1 = male, 0 = female.
- age age in years.
- year of operation.
- thickness tumour thickness in mm.
- ulcer 1 = presence, 0 = absence.

Source

menarche  

Description
Proportions of female children at various ages during adolescence who have reached menarche.

Usage
menarche

Format
This data frame contains the following columns:
- Age Average age of the group. (The groups are reasonably age homogeneous.)
- Total Total number of children in the group.
- Menarche Number who have reached menarche.
Source


The data are also given in

References


Examples

```r
mprob <- glm(cbind(Menarche, Total - Menarche) ~ Age,
              binomial(link = probit), data = menarche)
```

---

**michelson**

Michelson’s Speed of Light Data

**Description**

Measurements of the speed of light in air, made between 5th June and 2nd July, 1879. The data consists of five experiments, each consisting of 20 consecutive runs. The response is the speed of light in km/s, less 299000. The currently accepted value, on this scale of measurement, is 734.5.

**Usage**

`michelson`

**Format**

The data frame contains the following components:

- `expt` The experiment number, from 1 to 5.
- `run` The run number within each experiment.
- `speed` Speed-of-light measurement.

**Source**


**References**

minn38  
*Minnesota High School Graduates of 1938*

**Description**

The Minnesota high school graduates of 1938 were classified according to four factors, described below. The minn38 data frame has 168 rows and 5 columns.

**Usage**

minn38

**Format**

This data frame contains the following columns:

- **hs**  high school rank: "L", "M" and "U" for lower, middle and upper third.
- **phs** post high school status: Enrolled in college, ("C"), enrolled in non-collegiate school, ("N"), employed full-time, ("E") and other, ("O").
- **fol** father's occupational level, (seven levels, "F1", "F2", ..., "F7").
- **sex** sex: factor with levels "F" or "M".
- **f** frequency.

**Source**


who quotes the data from


---

motors  
*Accelerated Life Testing of Motorettes*

**Description**

The motors data frame has 40 rows and 3 columns. It describes an accelerated life test at each of four temperatures of 10 motorettes, and has rather discrete times.

**Usage**

motors
**Format**

This data frame contains the following columns:

- temp: the temperature (degrees C) of the test.
- time: the time in hours to failure or censoring at 8064 hours (= 336 days).
- cens: an indicator variable for death.

**Source**


taken from


**References**


**Examples**

```r
library(survival)
plot(survfit(Surv(time, cens) ~ factor(temp), motors), conf.int = FALSE)
# fit Weibull model
motor.wei <- survreg(Surv(time, cens) ~ temp, motors)
summary(motor.wei)
# and predict at 130°C
unlist(predict(motor.wei, data.frame(temp=130), se.fit = TRUE))

motor.cox <- coxph(Surv(time, cens) ~ temp, motors)
summary(motor.cox)
# predict at temperature 200
plot(survfit(motor.cox, newdata = data.frame(temp=200),
  conf.type = "log-log")
summary(survfit(motor.cox, newdata = data.frame(temp=130)))
```

---

**muscle**

*Effect of Calcium Chloride on Muscle Contraction in Rat Hearts*

**Description**

The purpose of this experiment was to assess the influence of calcium in solution on the contraction of heart muscle in rats. The left auricle of 21 rat hearts was isolated and on several occasions a constant-length strip of tissue was electrically stimulated and dipped into various concentrations of calcium chloride solution, after which the shortening of the strip was accurately measured as the response.
Usage

muscle

Format

This data frame contains the following columns:

- Strip  which heart muscle strip was used?
- Conc  concentration of calcium chloride solution, in multiples of 2.2 mM.
- Length  the change in length (shortening) of the strip, (allegedly) in mm.

Source


References


Examples

```r
A <- model.matrix(~ Strip - 1, data=muscle)
rats.nls1 <- nls(log(Length) ~ cbind(A, rho*Conc),
             data = muscle, start = c(rho=0.1), algorithm="plinear")
(B <- coef(rats.nls1))

st <- list(alpha = B[2:22], beta = B[23], rho = B[1])
(rats.nls2 <- nls(log(Length) ~ alpha[Strip] + beta*rho*Conc,
                 data = muscle, start = st))

Muscle <- with(muscle, {
  Muscle <- expand.grid(Conc = sort(unique(Conc)), Strip = levels(Strip))
  Muscle$Yhat <- predict(rats.nls2, Muscle)
  Muscle <- cbind(Muscle, logLength = rep(as.numeric(NA), 126))
  ind <- match(paste(Strip, Conc),
               paste(Muscle$Strip, Muscle$Conc))
  Muscle$logLength[ind] <- log(Length)
})

lattice::xyplot(Yhat ~ Conc | Strip, Muscle, as.table = TRUE,
                 ylim = range(c(Muscle$Yhat, Muscle$logLength), na.rm = TRUE),
                 subscripts = TRUE, xlab = "Calcium Chloride concentration (mM)",
                 ylab = "log(Length in mm)", panel =
                 function(x, y, subscripts, ...) {
                   panel.xyplot(x, Muscle$logLength[subscripts], ...)
                   llines(spline(x, y))
                 })
```
The function `mvrnorm` is used to simulate from a multivariate normal distribution. It takes several arguments:

- `n`: the number of samples required.
- `mu`: a vector giving the means of the variables.
- `Sigma`: a positive-definite symmetric matrix specifying the covariance matrix of the variables.
- `tol`: tolerance (relative to largest variance) for numerical lack of positive-definiteness in `Sigma`.
- `empirical`: logical. If true, `mu` and `Sigma` specify the empirical not population mean and covariance matrix.
- `eispack`: logical: values other than `FALSE` are an error.

The matrix decomposition is done via `eigen`; although a Choleski decomposition might be faster, the eigendecomposition is stabler.

If `n = 1` a vector of the same length as `mu`, otherwise an `n` by `length(mu)` matrix with one sample in each row.

Causes creation of the dataset `.Random.seed` if it does not already exist, otherwise its value is updated.

References


See Also

`rnorm`
## negative.binomial

### Family function for Negative Binomial GLMs

#### Description

Specifies the information required to fit a Negative Binomial generalized linear model, with known theta parameter, using `glm()`.  

#### Usage

```r
negative.binomial(theta = stop("'theta' must be specified"), link = "log")
```

#### Arguments

- `theta` The known value of the additional parameter, theta. 
- `link` The link function, as a character string, name or one-element character vector specifying one of `log`, `sqrt` or `identity`, or an object of class "link-glm".

#### Value

An object of class "family", a list of functions and expressions needed by `glm()` to fit a Negative Binomial generalized linear model.

#### References


#### See Also

- `glm.nb`, `anova.negbin`, `summary.negbin`

#### Examples

```r
# Fitting a Negative Binomial model to the quine data
# with theta = 2 assumed known.
#
# glm(Days ~ .^4, family = negative.binomial(2), data = quine)
```
**newcomb**

Newcomb’s Measurements of the Passage Time of Light

Description

A numeric vector giving the ‘Third Series’ of measurements of the passage time of light recorded by Newcomb in 1882. The given values divided by 1000 plus 24 give the time in millionths of a second for light to traverse a known distance. The ‘true’ value is now considered to be 33.02.

Usage

newcomb

Source


**nlschools**

Eighth-Grade Pupils in the Netherlands

Description

Snijders and Bosker (1999) use as a running example a study of 2287 eighth-grade pupils (aged about 11) in 132 classes in 131 schools in the Netherlands. Only the variables used in our examples are supplied.

Usage

nlschools

Format

This data frame contains 2287 rows and the following columns:

- lang: language test score.
- IQ: verbal IQ.
- class: class ID.
- GS: class size: number of eighth-grade pupils recorded in the class (there may be others: see COMB, and some may have been omitted with missing values).
- SES: social-economic status of pupil’s family.
- COMB: were the pupils taught in a multi-grade class (0/1)? Classes which contained pupils from grades 7 and 8 are coded 1, but only eighth-graders were tested.
Source

References

Examples
```r
nl1 <- within(nlschools, {
  IQave <- tapply(IQ, class, mean)[as.character(class)]
  IQ <- IQ - IQave
})
cen <- c("IQ", "IQave", "SES")
nl1[cen] <- scale(nl1[cen], center = TRUE, scale = FALSE)
nl.lme <- nlme::lme(lang ~ IQ*COMB + IQave + SES,
  random = ~ IQ | class, data = nl1)
summary(nl.lme)
```

npk

### Classical N, P, K Factorial Experiment

Description
A classical N, P, K (nitrogen, phosphate, potassium) factorial experiment on the growth of peas conducted on 6 blocks. Each half of a fractional factorial design confounding the NPK interaction was used on 3 of the plots.

Usage

npk

Format
The npk data frame has 24 rows and 5 columns:

- **block** which block (label 1 to 6).
- **N** indicator (0/1) for the application of nitrogen.
- **P** indicator (0/1) for the application of phosphate.
- **K** indicator (0/1) for the application of potassium.
- **yield** Yield of peas, in pounds/plot (the plots were (1/70) acre).
Note
This dataset is also contained in R 3.0.2 and later.

Source

References

Examples
options(contrasts = c("contr.sum", "contr.poly"))
npk.aov <- aov(yield ~ block + N*P*K, npk)
npk.aov
summary(npk.aov)
alias(npk.aov)
coef(npk.aov)
options(contrasts = c("contr.treatment", "contr.poly"))
npk.aov1 <- aov(yield ~ block + N + K, data = npk)
summary.lm(npk.aov1)
se.contrast(npk.aov1, list(N="0", N="1"), data = npk)
model.tables(npk.aov1, type = "means", se = TRUE)

npr1

US Naval Petroleum Reserve No. 1 data

Description
Data on the locations, porosity and permeability (a measure of oil flow) on 104 oil wells in the US Naval Petroleum Reserve No. 1 in California.

Usage
npr1

Format
This data frame contains the following columns:
x x coordinates, in miles (origin unspecified).
y y coordinates, in miles.
perm permeability in milli-Darcies.
por porosity (%).
Source

References

Null Spaces of Matrices

Description
Given a matrix, M, find a matrix N giving a basis for the (left) null space. That is \( \text{crossprod}(N, M) = t(N) \%\% M \) is an all-zero matrix and N has the maximum number of linearly independent columns.

Usage
\( \text{null}(M) \)

Arguments
- \( M \) Input matrix. A vector is coerced to a 1-column matrix.

Details
For a basis for the (right) null space \( \{x : Mx = 0\} \), use \( \text{null}(t(M)) \).

Value
The matrix N with the basis for the (left) null space, or a matrix with zero columns if the matrix M is square and of maximal rank.

References

See Also
- \text{qr}, \text{qr.Q}.

Examples
```r
# The function is currently defined as
function(M)
{
  tmp <- qr(M)
  set <- if(tmp$rank == 0L) seq_len(ncol(M)) else -seq_len(tmp$rank)
  qr.Q(tmp, complete = TRUE)[, set, drop = FALSE]
}
```
Description

The yield of oats from a split-plot field trial using three varieties and four levels of manurial treatment. The experiment was laid out in 6 blocks of 3 main plots, each split into 4 sub-plots. The varieties were applied to the main plots and the manurial treatments to the sub-plots.

Usage

oats

Format

This data frame contains the following columns:

- B Blocks, levels I, II, III, IV, V and VI.
- V Varieties, 3 levels.
- N Nitrogen (manurial) treatment, levels 0.0cwt, 0.2cwt, 0.4cwt and 0.6cwt, showing the application in cwt/acre.
- Y Yields in 1/4lbs per sub-plot, each of area 1/80 acre.

Source


References


Examples

oats$Nf <- ordered(oats$N, levels = sort(levels(oats$N)))
oats.aov <- aov(Y ~ NF*V + Error(B/V), data = oats, qr = TRUE)
summary(oats.aov)
summary(oats.aov, split = list(NF=list(L=1, Dev=2:3)))
par(mfrow = c(1,2), pty = "s")
plot(fitted(oats.aov[[4]]), studres(oats.aov[[4]]))
abline(h = 0, lty = 2)
oats.pr <- proj(oats.aov)
qqnorm(oats.pr[[4]][,"Residuals"], ylab = "Stratum 4 residuals")
qqline(oats.pr[[4]][,"Residuals"])
par(mfrow = c(1,1), pty = "m")
oats.aov2 <- aov(Y ~ N + V + Error(B/V), data = oats, qr = TRUE)
model.tables(oats.aov2, type = "means", se = TRUE)
Tests of Auditory Perception in Children with OME

Description

Experiments were performed on children on their ability to differentiate a signal in broad-band noise. The noise was played from a pair of speakers and a signal was added to just one channel; the subject had to turn his/her head to the channel with the added signal. The signal was either coherent (the amplitude of the noise was increased for a period) or incoherent (independent noise was added for the same period to form the same increase in power).

The threshold used in the original analysis was the stimulus loudness needs to get 75% correct responses. Some of the children had suffered from otitis media with effusion (OME).

Usage

OME

Format

The OME data frame has 1129 rows and 7 columns:

ID  Subject ID (1 to 99, with some IDs missing). A few subjects were measured at different ages.
OME  "low" or "high" or "N/A" (at ages other than 30 and 60 months).
Age  Age of the subject (months).
Loud  Loudness of stimulus, in decibels.
Noise  Whether the signal in the stimulus was "coherent" or "incoherent".
Correct  Number of correct responses from Trials trials.
Trials  Number of trials performed.

Background

The experiment was to study otitis media with effusion (OME), a very common childhood condition where the middle ear space, which is normally air-filled, becomes congested by a fluid. There is a concomitant fluctuating, conductive hearing loss which can result in various language, cognitive and social deficits. The term ‘binaural hearing’ is used to describe the listening conditions in which the brain is processing information from both ears at the same time. The brain computes differences in the intensity and/or timing of signals arriving at each ear which contributes to sound localisation and also to our ability to hear in background noise.

Some years ago, it was found that children of 7–8 years with a history of significant OME had significantly worse binaural hearing than children without such a history, despite having equivalent sensitivity. The question remained as to whether it was the timing, the duration, or the degree of severity of the otitis media episodes during critical periods, which affected later binaural hearing. In an attempt to begin to answer this question, 95 children were monitored for the presence of effusion every month since birth. On the basis of OME experience in their first two years, the test population was split into one group of high OME prevalence and one of low prevalence.
Source

Sarah Hogan, Dept of Physiology, University of Oxford, via Dept of Statistics Consulting Service

Examples

# Fit logistic curve from p = 0.5 to p = 1.0
fpl <- deriv(~ 0.5 + 0.5/(1 + exp(-(x-L75)/scal)),
c("L75", "scal"),
  function(x,L75,scal)NULL)
nls(Correct/Trials ~ fpl(Loud, L75, scal), data = OME,
  start = c(L75=45, scal=3))
nls(Correct/Trials ~ fpl(Loud, L75, scal),
  data = OME[OME$Noise == "coherent",],
  start = c(L75=45, scal=3))
nls(Correct/Trials ~ fpl(Loud, L75, scal),
  data = OME[OME$Noise == "incoherent",],
  start = c(L75=45, scal=3))

# individual fits for each experiment

aa <- factor(OME$Age)
ab <- 10*OME$ID + unclass(aa)
ac <- unclass(factor(ab))
OME$UID <- as.vector(ac)
OME$UIDn <- OME$UID + 0.1*(OME$Noise == "incoherent")
rm(aa, ab, ac)
OMEi <- OME

library(nlme)
fp2 <- deriv(~ 0.5 + 0.5/(1 + exp(-(x-L75)/2)),
  "L75", function(x,L75) NULL)
dec <- getOption("OutDec")
options(show.error.messages = FALSE, OutDec=".")
OMEi.nls <- nlsList(Correct/Trials ~ fp2(Loud, L75) | UIDn,
  data = OMEi, start = list(L75=45), control = list(maxiter=100))
options(show.error.messages = TRUE, OutDec=dec)
tmp <- sapply(OMEi.nls, function(x)
  {if(is.null(x)) NA else as.vector(coef(x)))}
OMEif <- data.frame(UID = round(as.numeric(names(tmp))),
  Noise = rep(c("coherent","incoherent"), 110),
  L75 = as.vector(tmp), stringsAsFactors = TRUE)
OMEif$Age <- OMEif$Age[match(OMEif$UID, OME$UID)]
OMEif$OME <- OMEif$OME[match(OMEif$UID, OME$UID)]
OMEif[OMEif[OMEif$L75 > 30,]]
summary(lm(L75 ~ Noise/Age, data = OMEif, na.action = na.omit))
summary(lm(L75 ~ Noise/(Age + OME), data = OMEif, subsect = (Age >= 30 & Age <= 60),
  na.action = na.omit), cor = FALSE)

# Or fit by weighted least squares
fpl75 <- deriv(~ sqrt(n)/(r/n - 0.5 - 0.5/(1 + exp(-(x-L75)/scal))),
c("L75", "scal"),
function(r, n, x, L75, scal) NULL)
nls(0 ~ fpl75(Correct, Trials, Loud, L75, scal),
    data = OME[OME$Noise == "coherent",],
    start = c(L75=45, scal=3))
nls(0 ~ fpl75(Correct, Trials, Loud, L75, scal),
    data = OME[OME$Noise == "incoherent",],
    start = c(L75=45, scal=3))

# Test to see if the curves shift with age
fpl75age <- deriv(~sqrt(n)*(r/n - 0.5 - 0.5/(1 +
    exp(-(x-L75-slope*age)/scal))),
    c("L75", "slope", "scal"),
    function(r, n, x, age, L75, slope, scal) NULL)

OME.nls1 <-
nls(0 ~ fpl75age(Correct, Trials, Loud, Age, L75, slope, scal),
    data = OME[OME$Noise == "coherent",],
    start = c(L75=45, slope=0, scal=2))
sqrt(diag(vcov(OME.nls1)))

OME.nls2 <-
nls(0 ~ fpl75age(Correct, Trials, Loud, Age, L75, slope, scal),
    data = OME[OME$Noise == "incoherent",],
    start = c(L75=45, slope=0, scal=2))
sqrt(diag(vcov(OME.nls2)))

# Now allow random effects by using NLME
OMEf <- OME[, rep(1:nrow(OME), OME$Trials),]
OMEf$Resp <- with(OME, rep(rep(c(1,0), length(Trials)),
    t(cbind(Correct, Trials-Correct))))
OMEf <- OMEf, -match(c("Correct", "Trials"), names(OMEf))]

## Not run: ## these fail in R on most platforms
fp2 <- deriv(~ 0.5 + 0.5/(1 + exp(-(x-L75)/exp(lsc))),
    c("L75", "lsc"),
    function(x, L75, lsc) NULL)
try(summary(nlme(Resp ~ fp2(Loud, L75, lsc),
    fixed = list(L75 ~ Age, lsc ~ 1),
    random = L75 + lsc ~ 1 | UID,
    data = OME[OME$Noise == "coherent",], method = "ML",
    start = list(fixed=c(L75=c(48.7, -0.03), lsc=0.24)), verbose = TRUE)))

try(summary(nlme(Resp ~ fp2(Loud, L75, lsc),
    fixed = list(L75 ~ Age, lsc ~ 1),
    random = L75 + lsc ~ 1 | UID,
    data = OME[OME$Noise == "incoherent",], method = "ML",
    start = list(fixed=c(L75=c(41.5, -0.1), lsc=0)), verbose = TRUE)))

## End(Not run)

painters

The Painter's Data of de Piles
**Description**

The subjective assessment, on a 0 to 20 integer scale, of 54 classical painters. The painters were assessed on four characteristics: composition, drawing, colour and expression. The data is due to the Eighteenth century art critic, de Piles.

**Usage**

painters

**Format**

The row names of the data frame are the painters. The components are:

- Composition
- Drawing
- Colour
- Expression

School

The school to which a painter belongs, as indicated by a factor level code as follows:

- "A": Renaissance;
- "B": Mannerist;
- "C": Seicento;
- "D": Venetian;
- "E": Lombard;
- "F": Sixteenth Century;
- "G": Seventeenth Century;
- "H": French.

**Source**


**References**


---

**pairs.lda**

*Produce Pairwise Scatterplots from an 'lda' Fit*

**Description**

Pairwise scatterplot of the data on the linear discriminants.

**Usage**

```r
# S3 method for class 'lda'
pairs(x, labels = colnames(x), panel = panel.lda,
     dimen, abbrev = FALSE, ..., cex=0.7, type = c("std", "trellis"))
```
Arguments

\texttt{x} \quad \textit{Object of class "lda".}
\texttt{labels} \quad \textit{vector of character strings for labelling the variables.}
\texttt{panel} \quad \textit{panel function to plot the data in each panel.}
\texttt{dimen} \quad \textit{The number of linear discriminants to be used for the plot; if this exceeds the number determined by \texttt{x} the smaller value is used.}
\texttt{abbrev} \quad \textit{whether the group labels are abbreviated on the plots. If \texttt{abbrev} > 0 this gives \texttt{minlength} in the call to \texttt{abbreviate}.}
\texttt{...} \quad \textit{additional arguments for \texttt{pairs.default}.}
\texttt{cex} \quad \textit{graphics parameter \texttt{cex} for labels on plots.}
\texttt{type} \quad \textit{type of plot. The default is in the style of \texttt{pairs.default}; the style "trellis" uses the Trellis function \texttt{splom}.}

Details

This function is a method for the generic function \texttt{pairs()} for class "lda". It can be invoked by calling \texttt{pairs(x)} for an object \texttt{x} of the appropriate class, or directly by calling \texttt{pairs.lda(x)} regardless of the class of the object.

References


See Also

\texttt{pairs}

\begin{verbatim}
parcoord \quad Parallel Coordinates Plot
\end{verbatim}

Description

Parallel coordinates plot

Usage

\texttt{parcoord(x, col = 1, lty = 1, var.label = FALSE, ...)}

Arguments

\texttt{x} \quad a matrix or data frame who columns represent variables. Missing values are allowed.
\texttt{col} \quad A vector of colours, recycled as necessary for each observation.
\texttt{lty} \quad A vector of line types, recycled as necessary for each observation.
\texttt{var.label} \quad If \texttt{TRUE}, each variable’s axis is labelled with maximum and minimum values.
\texttt{...} \quad Further graphics parameters which are passed to \texttt{matplot}. 

\end{verbatim}

\begin{verbatim}
parcoord \quad Parallel Coordinates Plot
\end{verbatim}

Description

Parallel coordinates plot

Usage

\texttt{parcoord(x, col = 1, lty = 1, var.label = FALSE, ...)}

Arguments

\texttt{x} \quad a matrix or data frame who columns represent variables. Missing values are allowed.
\texttt{col} \quad A vector of colours, recycled as necessary for each observation.
\texttt{lty} \quad A vector of line types, recycled as necessary for each observation.
\texttt{var.label} \quad If \texttt{TRUE}, each variable’s axis is labelled with maximum and minimum values.
\texttt{...} \quad Further graphics parameters which are passed to \texttt{matplot}. 

\end{verbatim}
**Side Effects**

- a parallel coordinates plots is drawn.

**Author(s)**

B. D. Ripley. Enhancements based on ideas and code by Fabian Scheipl.

**References**


**Examples**

```r
parcoord(state.x77[, c(7, 4, 6, 2, 5, 3)])

ir <- rbind(iris3[,1], iris3[,2], iris3[,3])
parcoord(log(ir)[, c(3, 4, 2, 1)], col = 1 + (0:149)/%50)
```

---

**petrol**

*N. L. Prater’s Petrol Refinery Data*

---

**Description**

The yield of a petroleum refining process with four covariates. The crude oil appears to come from only 10 distinct samples.

These data were originally used by Prater (1956) to build an estimation equation for the yield of the refining process of crude oil to gasoline.

**Usage**

`petrol`

**Format**

The variables are as follows

- `No`  crude oil sample identification label. (Factor.)
- `SG`  specific gravity, degrees API. (Constant within sample.)
- `VP`  vapour pressure in pounds per square inch. (Constant within sample.)
- `V10` volatility of crude; ASTM 10% point. (Constant within sample.)
- `EP`  desired volatility of gasoline. (The end point. Varies within sample.)
- `Y`  yield as a percentage of crude.
Source

This dataset is also given in D. J. Hand, F. Daly, K. McConway, D. Lunn and E. Ostrowski (eds) (1994) *A Handbook of Small Data Sets*. Chapman & Hall.

References


Examples

```r
library(nlme)
Petrol <- petrol
Petrol[, 2:5] <- scale(as.matrix(Petrol[, 2:5]), scale = FALSE)
pet3.lme <- lme(Y ~ SG + VP + V10 + EP,
               random = ~ 1 | No, data = Petrol)
pet3.lme <- update(pet3.lme, method = "ML")
pet4.lme <- update(pet3.lme, fixed = Y ~ V10 + EP)
anova(pet4.lme, pet3.lme)
```

---

**Pima.tr**

*Diabetes in Pima Indian Women*

**Description**

A population of women who were at least 21 years old, of Pima Indian heritage and living near Phoenix, Arizona, was tested for diabetes according to World Health Organization criteria. The data were collected by the US National Institute of Diabetes and Digestive and Kidney Diseases. We used the 532 complete records after dropping the (mainly missing) data on serum insulin.

**Usage**

- Pima.tr
- Pima.tr2
- Pima.te

**Format**

These data frames contains the following columns:

- `npreg` number of pregnancies.
- `glu` plasma glucose concentration in an oral glucose tolerance test.
- `bp` diastolic blood pressure (mm Hg).
- `skin` triceps skin fold thickness (mm).
- `bmi` body mass index (weight in kg/(height in m)^2).
- `ped` diabetes pedigree function.
- `age` age in years.
- `type` Yes or No, for diabetic according to WHO criteria.
Details

The training set `Pima.tr` contains a randomly selected set of 200 subjects, and `Pima.te` contains the remaining 332 subjects. `Pima.tr2` contains `Pima.tr` plus 100 subjects with missing values in the explanatory variables.

Source


Details

This function is a method for the generic function `plot()` for class "lda". It can be invoked by calling `plot(x)` for an object `x` of the appropriate class, or directly by calling `plot.lda(x)` regardless of the class of the object.

The behaviour is determined by the value of `dimen`. For `dimen > 2`, a pairs plot is used. For `dimen = 2`, an equiscaled scatter plot is drawn. For `dimen = 1`, a set of histograms or density plots are drawn. Use argument `type` to match "histogram" or "density" or "both".

References


See Also

`pairs.lda`, `ldahist.lda`, `predict.lda`

---

**plot.mca**

*Plot Method for Objects of Class 'mca'*

Description

Plot a multiple correspondence analysis.

Usage

```r
## S3 method for class 'mca'
plot(x, rows = TRUE, col, cex = par("cex"), ...)
```

Arguments

- `x` An object of class "mca".
- `rows` Should the coordinates for the rows be plotted, or just the vertices for the levels?
- `col, cex` The colours and `cex` to be used for the row points and level vertices respectively.
- `...` Additional parameters to `plot`.

References


See Also

`mca`, `predict.mca`

Examples

```r
plot(mca(farms, abbrev = TRUE))
```
plot.profile

Plotting Functions for 'profile' Objects

Description

plot and pairs methods for objects of class "profile".

Usage

## S3 method for class 'profile'
plot(x, ...)
## S3 method for class 'profile'
pairs(x, colours = 2:3, ...)

Arguments

x an object inheriting from class "profile".
colours Colours to be used for the mean curves conditional on x and y respectively.
... arguments passed to or from other methods.

details

This is the main plot method for objects created by profile.glm. It can also be called on objects created by profile.nls, but they have a specific method, plot.profile.nls.

The pairs method shows, for each pair of parameters x and y, two curves intersecting at the maximum likelihood estimate, which give the loci of the points at which the tangents to the contours of the bivariate profile likelihood become vertical and horizontal, respectively. In the case of an exactly bivariate normal profile likelihood, these two curves would be straight lines giving the conditional means of y|x and x|y, and the contours would be exactly elliptical.

Author(s)

Originally, D. M. Bates and W. N. Venables. (For S in 1996.)

See Also

profile.glm, profile.nls.

Examples

## see ?profile.glm for an example using glm fits.

## a version of example(profile.nls) from R >= 2.8.0
fm1 <- nls(demand ~ SSasymOrig(Time, A, lrc), data = BOD)
pr1 <- profile(fm1, alpha = 0.1)
MASS:::plot.profile(pr1)
pairs(pr1) # a little odd since the parameters are highly correlated
## polr

**Ordered Logistic or Probit Regression**

### Description

Fits a logistic or probit regression model to an ordered factor response. The default logistic case is *proportional odds logistic regression*, after which the function is named.

### Usage

```r
polr(formula, data, weights, start, ..., subset, na.action,
     contrasts = NULL, Hess = FALSE, model = TRUE,
     method = c("logistic", "probit", "loglog", "cloglog", "cauchit"))
```

### Arguments

- **formula**: a formula expression as for regression models, of the form `response ~ predictors`. The response should be a factor (preferably an ordered factor), which will be interpreted as an ordinal response, with levels ordered as in the factor. The model must have an intercept: attempts to remove one will lead to a warning and be ignored. An offset may be used. See the documentation of `formula` for other details.

- **data**: an optional data frame in which to interpret the variables occurring in `formula`.

- **weights**: optional case weights in fitting. Default to 1.

- **start**: initial values for the parameters. This is in the format `c(coefficients, zeta)`: see the Values section.

- **...**: additional arguments to be passed to `optim`, most often a control argument.

- **subset**: expression saying which subset of the rows of the data should be used in the fit. All observations are included by default.

- **na.action**: a function to filter missing data.

- **contrasts**: a list of contrasts to be used for some or all of the factors appearing as variables in the model formula.

- **Hess**: logical for whether the Hessian (the observed information matrix) should be returned. Use this if you intend to call `summary` or `vcov` on the fit.

- **model**: logical for whether the model matrix should be returned.

- **method**: logistic or probit or (complementary) log-log or cauchit (corresponding to a Cauchy latent variable).

---

```r
# an example from ?nls
x <- -(1:100)/10
y <- 100 + 10 * exp(x / 2) + rnorm(x)/10
nlmod <- nls(y ~ Const + A * exp(B * x), start=list(Const=100, A=10, B=1))
pairs(profile(nlmod))
```
Details

This model is what Agresti (2002) calls a *cumulative link* model. The basic interpretation is as a *coarsened* version of a latent variable $Y_i$ which has a logistic or normal or extreme-value or Cauchy distribution with scale parameter one and a linear model for the mean. The ordered factor which is observed is which bin $Y_i$ falls into with breakpoints

$$\zeta_0 = -\infty < \zeta_1 < \cdots < \zeta_K = \infty$$

This leads to the model

$$\logit P(Y \leq k| x) = \zeta_k - \eta$$

with *logit* replaced by *probit* for a normal latent variable, and $\eta$ being the linear predictor, a linear function of the explanatory variables (with no intercept). Note that it is quite common for other software to use the opposite sign for $\eta$ (and hence the coefficients beta).

In the logistic case, the left-hand side of the last display is the log odds of category $k$ or less, and since these are log odds which differ only by a constant for different $k$, the odds are proportional. Hence the term *proportional odds logistic regression*.

The log-log and complementary log-log links are the increasing functions $F^{-1}(p) = -\log(-\log(p))$ and $F^{-1}(p) = \log(-\log(1 - p))$; some call the first the ‘negative log-log’ link. These correspond to a latent variable with the extreme-value distribution for the maximum and minimum respectively.

A *proportional hazards* model for grouped survival times can be obtained by using the complementary log-log link with grouping ordered by increasing times.

`predict`, `summary`, `vcov`, `anova`, `model.frame` and an `extractAIC` method for use with `stepAIC` (and `step`). There are also `profile` and `confint` methods.

Value

A object of class "polr". This has components

- `coefficients` the coefficients of the linear predictor, which has no intercept.
- `zeta` the intercepts for the class boundaries.
- `deviance` the residual deviance.
- `fitted.values` a matrix, with a column for each level of the response.
- `lev` the names of the response levels.
- `terms` the terms structure describing the model.
- `df.residual` the number of residual degrees of freedoms, calculated using the weights.
- `edf` the (effective) number of degrees of freedom used by the model.
- `n, nobs` the (effective) number of observations, calculated using the weights. (`nobs` is for use by `stepAIC`.
- `call` the matched call.
- `method` the matched method used.
- `convergence` the convergence code returned by `optim`.
- `niter` the number of function and gradient evaluations used by `optim`.
- `lp` the linear predictor (including any offset).
- `Hessian` (if `Hess` is true). Note that this is a numerical approximation derived from the optimization process.
- `model` (if `model` is true).
Note

The \texttt{vcov} method uses the approximate Hessian: for reliable results the model matrix should be sensibly scaled with all columns having range the order of one.

Prior to version 7.3-32, \texttt{method = "cloglog"} confusingly gave the log-log link, implicitly assuming the first response level was the ‘best’.

References


See Also

\texttt{optim}, \texttt{glm}, \texttt{multinom}.

Examples

```r
options(contrasts = c("contr.treatment", "contr.poly"))
house.plr <- polr(Sat ~ Infl + Type + Cont, weights = Freq, data = housing)
house.plr
summary(house.plr, digits = 3)
## slightly worse fit from
summary(update(house.plr, method = "probit", Hess = TRUE), digits = 3)
## although it is not really appropriate, can fit
summary(update(house.plr, method = "loglog", Hess = TRUE), digits = 3)
summary(update(house.plr, method = "cloglog", Hess = TRUE), digits = 3)
predict(house.plr, housing, type = "p")
addterm(house.plr, ~.^2, test = "Chisq")
house.plr2 <- stepAIC(house.plr, ~.^2)
house.plr2$anova
anova(house.plr, house.plr2)

house.plr <- update(house.plr, Hess=TRUE)
pr <- profile(house.plr)
confint(pr)
plot(pr)
pairs(pr)
```

\texttt{predict.glmmPQL} \hspace{1cm} \textit{Predict Method for glmmPQL Fits}

Description

Obtains predictions from a fitted generalized linear model with random effects.
Usage

```r
predict(object, newdata = NULL, type = c("link", "response"),
         level, na.action = na.pass, ...)
```

Arguments

- **object**: a fitted object of class inheriting from "glmmPQL".
- **newdata**: optionally, a data frame in which to look for variables with which to predict.
- **type**: the type of prediction required. The default is on the scale of the linear predictors; the alternative "response" is on the scale of the response variable. Thus for a default binomial model the default predictions are of log-odds (probabilities on logit scale) and `type = "response"` gives the predicted probabilities.
- **level**: an optional integer vector giving the level(s) of grouping to be used in obtaining the predictions. Level values increase from outermost to innermost grouping, with level zero corresponding to the population predictions. Defaults to the highest or innermost level of grouping.
- **na.action**: function determining what should be done with missing values in `newdata`. The default is to predict `NA`.
- **...**: further arguments passed to or from other methods.

Value

If `level` is a single integer, a vector otherwise a data frame.

See Also

`glmmPQL`, `predict.lme`.

Examples

```r
fit <- glmmPQL(y ~ trt + I(week > 2), random = ~1 | ID,
               family = binomial, data = bacteria)
predict(fit, bacteria, level = 0, type="response")
predict(fit, bacteria, level = 1, type="response")
```

---

**predict.lda**

**Classify Multivariate Observations by Linear Discrimination**

**Description**

Classify multivariate observations in conjunction with `lda`, and also project data onto the linear discriminants.
Usage

```r
## S3 method for class 'lda'
predict(object, newdata, prior = object$prior, dimen,
       method = c("plug-in", "predictive", "debiased"), ...)
```

Arguments

- `object`: object of class "lda"
- `newdata`: data frame of cases to be classified or, if object has a formula, a data frame with columns of the same names as the variables used. A vector will be interpreted as a row vector. If newdata is missing, an attempt will be made to retrieve the data used to fit the lda object.
- `prior`: The prior probabilities of the classes, by default the proportions in the training set or what was set in the call to lda.
- `dimen`: the dimension of the space to be used. If this is less than \( \min(p, ng-1) \), only the first `dimen` discriminant components are used (except for `method="predictive"`), and only those dimensions are returned in `x`.
- `method`: This determines how the parameter estimation is handled. With "plug-in" (the default) the usual unbiased parameter estimates are used and assumed to be correct. With "debiased" an unbiased estimator of the log posterior probabilities is used, and with "predictive" the parameter estimates are integrated out using a vague prior.
- `...`: arguments based from or to other methods

Details

This function is a method for the generic function `predict()` for class "lda". It can be invoked by calling `predict(x)` for an object `x` of the appropriate class, or directly by calling `predict.lda(x)` regardless of the class of the object.

Missing values in `newdata` are handled by returning `NA` if the linear discriminants cannot be evaluated. If `newdata` is omitted and the `na.action` of the fit omitted cases, these will be omitted on the prediction.

This version centres the linear discriminants so that the weighted mean (weighted by `prior`) of the group centroids is at the origin.

Value

a list with components

- `class`: The MAP classification (a factor)
- `posterior`: posterior probabilities for the classes
- `x`: the scores of test cases on up to `dimen` discriminant variables

References

predict.lqs

See Also

lda, qda, predict.qda

Examples

tr <- sample(1:50, 25)
train <- rbind(iris3[tr,1], iris3[tr,2], iris3[tr,3])

test <- rbind(iris3[-tr,1], iris3[-tr,2], iris3[-tr,3])
c1 <- factor(c(rep("s",25), rep("c",25), rep("v",25)))
z <- lda(train, c1)
predict(z, test)$class

Description

Predict from an resistant regression fitted by lqs.

Usage

## S3 method for class 'lqs'
predict(object, newdata, na.action = na.pass, ...)

Arguments

object object inheriting from class "lqs"
newdata matrix or data frame of cases to be predicted or, if object has a formula, a data frame with columns of the same names as the variables used. A vector will be interpreted as a row vector. If newdata is missing, an attempt will be made to retrieve the data used to fit the lqs object.
na.action function determining what should be done with missing values in newdata. The default is to predict NA.
... arguments to be passed from or to other methods.

details

This function is a method for the generic function predict() for class lqs. It can be invoked by calling predict(x) for an object x of the appropriate class, or directly by calling predict.lqs(x) regardless of the class of the object.

Missing values in newdata are handled by returning NA if the linear fit cannot be evaluated. If newdata is omitted and the na.action of the fit omitted cases, these will be omitted on the prediction.

Value

A vector of predictions.
predict.mca

Author(s)
B.D. Ripley

See Also
lqs

Examples

```r
set.seed(123)
fm <- lqs(stack.loss ~ ., data = stackloss, method = "S", nsamp = "exact")
predict(fm, stackloss)
```

predict.mca

Predict Method for Class 'mca'

Description

Used to compute coordinates for additional rows or additional factors in a multiple correspondence analysis.

Usage

```r
## S3 method for class 'mca'
predict(object, newdata, type = c("row", "factor"), ...)
```

Arguments

- `object`: An object of class "mca", usually the result of a call to mca.
- `newdata`: A data frame containing either additional rows of the factors used to fit object or additional factors for the cases used in the original fit.
- `type`: Are predictions required for further rows or for new factors?
- `...`: Additional arguments from predict: unused.

Value

If `type` = "row", the coordinates for the additional rows.
If `type` = "factor", the coordinates of the column vertices for the levels of the new factors.

References


See Also

mca, plot.mca
predict.qda

Classify from Quadratic Discriminant Analysis

Description

Classify multivariate observations in conjunction with qda

Usage

```r
## S3 method for class 'qda'
predict(object, newdata, prior = object$prior,
    method = c("plug-in", "predictive", "debiased", "loocv"), ...)
```

Arguments

- `object`: object of class "qda"
- `newdata`: data frame of cases to be classified or, if object has a formula, a data frame with columns of the same names as the variables used. A vector will be interpreted as a row vector. If newdata is missing, an attempt will be made to retrieve the data used to fit the qda object.
- `prior`: The prior probabilities of the classes, by default the proportions in the training set or what was set in the call to qda.
- `method`: This determines how the parameter estimation is handled. With "plug-in" (the default) the usual unbiased parameter estimates are used and assumed to be correct. With "debiased" an unbiased estimator of the log posterior probabilities is used, and with "predictive" the parameter estimates are integrated out using a vague prior. With "loocv" the leave-one-out cross-validation fits to the original dataset are computed and returned.

Details

This function is a method for the generic function `predict()` for class "qda". It can be invoked by calling `predict(x)` for an object `x` of the appropriate class, or directly by calling `predict.qda(x)` regardless of the class of the object.

Missing values in `newdata` are handled by returning `NA` if the quadratic discriminants cannot be evaluated. If `newdata` is omitted and the `na.action` of the fit omitted cases, these will be omitted on the prediction.

Value

A list with components

- `class`: The MAP classification (a factor)
- `posterior`: posterior probabilities for the classes
### References


### See Also

`qda`, `lda`, `predict.lda`

### Examples

```r
tr <- sample(1:50, 25)
train <- rbind(iris3[tr, 1], iris3[tr, 2], iris3[tr, 3])

train <- rbind(iris3[-tr, 1], iris3[-tr, 2], iris3[-tr, 3])

c1 <- factor(c(rep("s", 25), rep("c", 25), rep("v", 25)))

zq <- qda(train, cl)
predict(zq, test)$class
```

---

### profile.glm

#### Method for Profiling glm Objects

**Description**

Investigates the profile log-likelihood function for a fitted model of class "glm".

**Usage**

```r
# S3 method for class 'glm'
profile(fitted, which = 1:p, alpha = 0.01, maxsteps = 10,
    del = zmax/5, trace = FALSE, ...)
```

**Arguments**

- `fitted` the original fitted model object.
- `which` the original model parameters which should be profiled. This can be a numeric or character vector. By default, all parameters are profiled.
- `alpha` highest significance level allowed for the profile t-statistics.
- `maxsteps` maximum number of points to be used for profiling each parameter.
- `del` suggested change on the scale of the profile t-statistics. Default value chosen to allow profiling at about 10 parameter values.
- `trace` logical: should the progress of profiling be reported?
- `...` further arguments passed to or from other methods.

**Details**

The profile t-statistic is defined as the square root of change in sum-of-squares divided by residual standard error with an appropriate sign.
qda

Description

Quadratic discriminant analysis.

Value

A list of classes "profile.glm" and "profile" with an element for each parameter being profiled. The elements are data-frames with two variables:

- `par.vals`: a matrix of parameter values for each fitted model.
- `tau`: the profile t-statistics.

Author(s)

Originally, D. M. Bates and W. N. Venables. (For S in 1996.)

See Also

`glm`, `profile`, `plot.profile`

Examples

```r
options(contrasts = c("contr.treatment", "contr.poly"))
ldose <- rep(0:5, 2)
umdead <- c(1, 4, 9, 13, 18, 20, 0, 2, 6, 10, 12, 16)
sex <- factor(rep(c("M", "F"), c(6, 6)))
SF <- cbind(numdead, numalive = 20 - numdead)
budworm.lg <- glm(SF ~ sex*ldose, family = binomial)
pr1 <- profile(budworm.lg)
plot(pr1)
pairs(pr1)
```

---

Quadratic Discriminant Analysis

Usage

```r
qda(x, ...)
```

## S3 method for class 'formula'
```
qda(formula, data, ..., subset, na.action)
```

## Default S3 method:
```
qda(x, grouping, prior = proportions, method, CV = FALSE, nu, ...)
```

## S3 method for class 'data.frame'
```
qda(x, ...)
```
## S3 method for class 'matrix'
qda(x, grouping, ..., subset, na.action)

### Arguments

- **formula**: A formula of the form `groups ~ x_1 + x_2 + ...`. That is, the response is the grouping factor and the right hand side specifies the (non-factor) discriminators.
- **data**: Data frame from which variables specified in formula are preferentially to be taken.
- **x**: (required if no formula is given as the principal argument.) A matrix or data frame or Matrix containing the explanatory variables.
- **grouping**: (required if no formula principal argument is given.) A factor specifying the class for each observation.
- **prior**: the prior probabilities of class membership. If unspecified, the class proportions for the training set are used. If specified, the probabilities should be specified in the order of the factor levels.
- **subset**: An index vector specifying the cases to be used in the training sample. (NOTE: If given, this argument must be named.)
- **na.action**: A function to specify the action to be taken if NAs are found. The default action is for the procedure to fail. An alternative is na.omit, which leads to rejection of cases with missing values on any required variable. (NOTE: If given, this argument must be named.)
- **method**: "moment" for standard estimators of the mean and variance, "mle" for MLEs, "mve" to use cov.mve, or "t" for robust estimates based on a t distribution.
- **CV**: If true, returns results (classes and posterior probabilities) for leave-out-out cross-validation. Note that if the prior is estimated, the proportions in the whole dataset are used.
- **nu**: degrees of freedom for method = "t".
- **...**: arguments passed to or from other methods.

### Details

Uses a QR decomposition which will give an error message if the within-group variance is singular for any group.

### Value

An object of class "qda" containing the following components:

- **prior**: the prior probabilities used.
- **means**: the group means.
- **scaling**: for each group `i`, `scaling[,i]` is an array which transforms observations so that within-groups covariance matrix is spherical.
- **ldet**: a vector of half log determinants of the dispersion matrix.
- **lev**: the levels of the grouping factor.
description of the objects and their purposes. For example, the terms object summarizes the formula.

call

the (matched) function call.

unless CV=TRUE, when the return value is a list with components:

class

The MAP classification (a factor)

posterior

posterior probabilities for the classes

References


See Also

predict.qda, lda

Examples

tr <- sample(1:50, 25)
train <- rbind(iris3[train,1], iris3[train,2], iris3[train,3])
test <- rbind(iris3[-train,1], iris3[-train,2], iris3[-train,3])
c1 <- factor(c(rep("s",25), rep("c",25), rep("v",25)))

z <- qda(train, c1)
predict(z,test)$class

Description

The quine data frame has 146 rows and 5 columns. Children from Walgett, New South Wales, Australia, were classified by Culture, Age, Sex and Learner status and the number of days absent from school in a particular school year was recorded.

Usage

quine

Format

This data frame contains the following columns:

eth  ethnic background: Aboriginal or Not, ("A" or "N").
sex  sex: factor with levels ("F" or "M").
age  age group: Primary ("F0"), or forms "F1," "F2" or "F3".
lrn  learner status: factor with levels Average or Slow learner, ("AL" or "SL").
days days absent from school in the year.
**Blood Pressure in Rabbits**

**Description**

Five rabbits were studied on two occasions, after treatment with saline (control) and after treatment with the $5-HT_3$ antagonist MDL 72222. After each treatment ascending doses of phenylbiguanide were injected intravenously at 10 minute intervals and the responses of mean blood pressure measured. The goal was to test whether the cardiogenic chemoreflex elicited by phenylbiguanide depends on the activation of $5-HT_3$ receptors.

**Usage**

Rabbit

**Format**

This data frame contains 60 rows and the following variables:

- `bpchange` change in blood pressure relative to the start of the experiment.
- `dose` dose of Phenylbiguanide in micrograms.
- `run` label of run ("C1" to "C5", then "M1" to "M5").
- `treatment` placebo or the $5-HT_3$ antagonist MDL 72222.
- `animal` label of animal used ("R1" to "R5").

**Source**


[The numerical data are not in the paper but were supplied by Professor Ludbrook]

**References**

**rational**

*Rational Approximation*

**Description**

Find rational approximations to the components of a real numeric object using a standard continued fraction method.

**Usage**

```r
rational(x, cycles = 10, max.denominator = 2000, ...)
```

**Arguments**

- `x` Any object of mode numeric. Missing values are now allowed.
- `cycles` The maximum number of steps to be used in the continued fraction approximation process.
- `max.denominator` An early termination criterion. If any partial denominator exceeds `max.denominator` the continued fraction stops at that point.
- `...` arguments passed to or from other methods.

**Details**

Each component is first expanded in a continued fraction of the form

\[
x = \text{floor}(x) + \frac{1}{p_1 + \frac{1}{p_2 + \ldots}}
\]

where \(p_1, p_2, \ldots\) are positive integers, terminating either at `cycles` terms or when a \(p_j > \text{max.denominator}\). The continued fraction is then re-arranged to retrieve the numerator and denominator as integers and the ratio returned as the value.

**Value**

A numeric object with the same attributes as `x` but with entries rational approximations to the values. This effectively rounds relative to the size of the object and replaces very small entries by zero.

**See Also**

`fractions`

**Examples**

```r
X <- matrix(runif(25), 5, 5)
zapsmall(solve(X, X/5)) # print near-zeroes as zero
rational(solve(X, X/5))
```
renumerate  

Convert a Formula Transformed by 'denumerate'

Description

denumerate converts a formula written using the conventions of loglm into one that terms is able to process. renumerate converts it back again to a form like the original.

Usage

renumerate(x)

Arguments

x  
A formula, normally as modified by denumerate.

Details

This is an inverse function to denumerate. It is only needed since terms returns an expanded form of the original formula where the non-marginal terms are exposed. This expanded form is mapped back into a form corresponding to the one that the user originally supplied.

Value

A formula where all variables with names of the form .vn, where n is an integer, converted to numbers, n, as allowed by the formula conventions of loglm.

See Also

denumerate

Examples

denumerate(~(1+2+3)^3 + a/b)
## ~ (.v1 + .v2 + .v3)^3 + a/b
renumerate(.Last.value)
## ~ (1 + 2 + 3)^3 + a/b
Description

Fit a linear model by robust regression using an M estimator.

Usage

```r
rlm(x, ...) # S3 method for class 'formula'
rlm(formula, data, weights, ..., subset, na.action,
    method = c("M", "MM", "model.frame"),
    wt.method = c("inv.var", "case"),
    model = TRUE, x.ret = TRUE, y.ret = FALSE, contrasts = NULL)
```

Arguments

- **formula**: a formula of the form `y ~ x1 + x2 + ....`
- **data**: data frame from which variables specified in formula are preferentially to be taken.
- **weights**: a vector of prior weights for each case.
- **subset**: An index vector specifying the cases to be used in fitting.
- **na.action**: A function to specify the action to be taken if NAs are found. The ‘factory-fresh’ default action in R is `na.omit`, and can be changed by `options(na.action=)`. 
- **x**: a matrix or data frame containing the explanatory variables.
- **y**: the response: a vector of length the number of rows of `x`.
- **method**: currently either M-estimation or MM-estimation or (for the formula method only) find the model frame. MM-estimation is M-estimation with Tukey’s biweight initialized by a specific S-estimator. See the ‘Details’ section.
- **wt.method**: are the weights case weights (giving the relative importance of case, so a weight of 2 means there are two of these) or the inverse of the variances, so a weight of two means this error is half as variable?
model should the model frame be returned in the object?
x.ret should the model matrix be returned in the object?
y.ret should the response be returned in the object?
contrasts optional contrast specifications: see \texttt{lm}.
w (optional) initial down-weighting for each case.
init (optional) initial values for the coefficients OR a method to find initial values OR the result of a fit with a \texttt{coef} component. Known methods are "ls" (the default) for an initial least-squares fit using weights \texttt{w*weights}, and "lts" for an unweighted least-trimmed squares fit with 200 samples.
psi the psi function is specified by this argument. It must give (possibly by name) a function \(g(x, \ldots, \text{deriv})\) that for \text{deriv}=0 returns \(\psi(x)/x\) and for \text{deriv}=1 returns \(\psi'(x)\). Tuning constants will be passed in via \ldots
scale.est method of scale estimation: re-scaled MAD of the residuals (default) or Huber’s proposal 2 (which can be selected by either "Huber" or "proposal 2").
k2 tuning constant used for Huber proposal 2 scale estimation.
maxit the limit on the number of IWLS iterations.
acc the accuracy for the stopping criterion.
test.vec the stopping criterion is based on changes in this vector.
\ldots additional arguments to be passed to \texttt{rlm.default} or to the psi function.
lqs.control An optional list of control values for \texttt{lqs}.
u numeric vector of evaluation points.
k, a, b, c tuning constants.
deriv 0 or 1: compute values of the psi function or of its first derivative.

Details

Fitting is done by iterated re-weighted least squares (IWLS).

Psi functions are supplied for the Huber, Hampel and Tukey bisquare proposals as \texttt{psi.huber}, \texttt{psi.hampel} and \texttt{psi.bisquare}. Huber’s corresponds to a convex optimization problem and gives a unique solution (up to collinearity). The other two will have multiple local minima, and a good starting point is desirable.

Selecting \texttt{method = "MM"} selects a specific set of options which ensures that the estimator has a high breakdown point. The initial set of coefficients and the final scale are selected by an S-estimator with \(k_0 = 1.548\); this gives (for \(n \gg p\)) breakdown point 0.5. The final estimator is an M-estimator with Tukey’s biweight and fixed scale that will inherit this breakdown point provided \(c > k_0\); this is true for the default value of \(c\) that corresponds to 95% relative efficiency at the normal. Case weights are not supported for \texttt{method = "MM"}.

Value

An object of class "\texttt{rlm}" inheriting from "\texttt{lm}". Note that the \texttt{df.residual} component is deliberately set to \texttt{NA} to avoid inappropriate estimation of the residual scale from the residual mean square by "\texttt{lm}" methods.

The additional components not in an \texttt{lm} object are
**rms.curv**

Relative Curvature Measures for Non-Linear Regression

### Description

Calculates the root mean square parameter effects and intrinsic relative curvatures, \( c^0 \) and \( c^\prime \), for a fitted nonlinear regression, as defined in Bates & Watts, section 7.3, p. 253ff

### Usage

```
rms.curv(obj)
```

### Arguments

- **obj**: Fitted model object of class "nls". The model must be fitted using the default algorithm.

### Examples

```
summary(rlm(stack.loss ~ ., stackloss))
rlm(stack.loss ~ ., stackloss, psi = psi.hampel, init = "lts")
rlm(stack.loss ~ ., stackloss, psi = psi.bisquare)
```
Details

The method of section 7.3.1 of Bates & Watts is implemented. The function deriv3 should be used to generate a model function with first derivative (gradient) matrix and second derivative (Hessian) array attributes. This function should then be used to fit the nonlinear regression model.

A print method, print.rms.curv, prints the pc and ic components only, suitably annotated.

If either pc or ic exceeds some threshold (0.3 has been suggested) the curvature is unacceptably high for the planar assumption.

Value

A list of class rms.curv with components pc and ic for parameter effects and intrinsic relative curvatures multiplied by sqrt(F), ct and ci for c^θ and c^ι (unmultiplied), and C the C-array as used in section 7.3.1 of Bates & Watts.

References


See Also

deriv3

Examples

```r
# The treated sample from the Puromycin data
mmcurve <- deriv3(~ Vm * conc/(K + conc), c("Vm", "K"),
                   function(Vm, K, conc) NULL)
Treated <- Puromycin[Puromycin$state == "treated", ]
(Purfit1 <- nls(rate ~ mmcurve(Vm, K, conc), data = Treated,
               start = list(Vm=200, K=0.1)))

rms.curv(Purfit1)
##Parameter effects: c^theta x sqrt(F) = 0.2121
##Intrinsic: c^iota x sqrt(F) = 0.092
```

---

**rnegbin**  
*Simulate Negative Binomial Variates*

Description

Function to generate random outcomes from a Negative Binomial distribution, with mean $\mu$ and variance $\mu + \mu^2/\theta$.

Usage

```r
rnegbin(n, mu = n, theta = stop("'theta' must be specified"))
```
**Arguments**

- `n`: If a scalar, the number of sample values required. If a vector, `length(n)` is the number required and `n` is used as the mean vector if `mu` is not specified.
- `mu`: The vector of means. Short vectors are recycled.
- `theta`: Vector of values of the `theta` parameter. Short vectors are recycled.

**Details**

The function uses the representation of the Negative Binomial distribution as a continuous mixture of Poisson distributions with Gamma distributed means. Unlike `rnbinom`, the index can be arbitrary.

**Value**

Vector of random Negative Binomial variate values.

**Side Effects**

Changes `.Random.seed` in the usual way.

**Examples**

```r
# Negative Binomials with means fitted(fm) and theta = 4.5
fm <- glm.nb(Days ~ ., data = quine)
dummy <- rnegbin(fitted(fm), theta = 4.5)
```

---

**Description**

A data frame with the annual deaths in road accidents for half the US states.

**Usage**

`road`

**Format**

Columns are:

- `state`: name.
- `deaths`: number of deaths.
- `drivers`: number of drivers (in 10,000s).
- `popden`: population density in people per square mile.
- `rural`: length of rural roads, in 1000s of miles.
- `temp`: average daily maximum temperature in January.
- `fuel`: fuel consumption in 10,000,000 US gallons per year.
Source

Imperial College, London M.Sc. exercise

rotifer Numbers of Rotifers by Fluid Density

Description

The data give the numbers of rotifers falling out of suspension for different fluid densities. There are two species, \textit{pm} Polyartha major and \textit{kc}, Keratella cochlearis and for each species the number falling out and the total number are given.

Usage

rotifer

Format

density specific density of fluid.
\textit{pm} . \textit{y} number falling out for \textit{P. major}.
\textit{pm} . \textit{total} total number of \textit{P. major}.
\textit{kc} . \textit{y} number falling out for \textit{K. cochlearis}.
\textit{kc} . \textit{tot} total number of \textit{K. cochlearis}.

Source


Rubber Accelerated Testing of Tyre Rubber

Description

Data frame from accelerated testing of tyre rubber.

Usage

Rubber

Format

\textit{loss} the abrasion loss in gm/hr.
\textit{hard} the hardness in Shore units.
\textit{tens} tensile strength in kg/sq m.
Sammon's Non-Linear Mapping

Description

One form of non-metric multidimensional scaling.

Usage

```r
sammon(d, y = cmdscale(d, k), k = 2, niter = 100, trace = TRUE,
       magic = 0.2, tol = 1e-4)
```

Arguments

d  distance structure of the form returned by `dist`, or a full, symmetric matrix. Data are assumed to be dissimilarities or relative distances, but must be positive except for self-distance. This can contain missing values.

y  An initial configuration. If none is supplied, `cmdscale` is used to provide the classical solution. (If there are missing values in `d`, an initial configuration must be provided.) This must not have duplicates.

k  The dimension of the configuration.

niter  The maximum number of iterations.

trace  Logical for tracing optimization. Default `TRUE`.

magic  initial value of the step size constant in diagonal Newton method.

tol  Tolerance for stopping, in units of stress.

Details

This chooses a two-dimensional configuration to minimize the stress, the sum of squared differences between the input distances and those of the configuration, weighted by the distances, the whole sum being divided by the sum of input distances to make the stress scale-free.

An iterative algorithm is used, which will usually converge in around 50 iterations. As this is necessarily an $O(n^2)$ calculation, it is slow for large datasets. Further, since the configuration is only determined up to rotations and reflections (by convention the centroid is at the origin), the result can vary considerably from machine to machine. In this release the algorithm has been modified by adding a step-length search (`magic`) to ensure that it always goes downhill.
Value

Two components:
- **points**: A two-column vector of the fitted configuration.
- **stress**: The final stress achieved.

Side Effects

If trace is true, the initial stress and the current stress are printed out every 10 iterations.

References


See Also

`cmdscale`, `isoMDS`

Examples

```r
swiss.x <- as.matrix(swiss[, -1])
swiss.sam <- sammon(dist(swiss.x))
plot(swiss.sam$points, type = "n")
text(swiss.sam$points, labels = as.character(1:nrow(swiss.x)))
```

---

**ships**

*Ships Damage Data*

Description

Data frame giving the number of damage incidents and aggregate months of service by ship type, year of construction, and period of operation.

Usage

`ships`

Format

- **type**: "A" to "E".
- **year**: year of construction: 1960–64, 65–69, 70–74, 75–79 (coded as "60", "65", "70", "75").
- **period**: period of operation: 1960–74, 75–79.
- **service**: aggregate months of service.
- **incidents**: number of damage incidents.
**shoes**

**Source**


---

**shoes**

*Shoe wear data of Box, Hunter and Hunter*

---

**Description**

A list of two vectors, giving the wear of shoes of materials A and B for one foot each of ten boys.

**Usage**

shoes

---

**Source**


---

**References**


---

**shrimp**

*Percentage of Shrimp in Shrimp Cocktail*

---

**Description**

A numeric vector with 18 determinations by different laboratories of the amount (percentage of the declared total weight) of shrimp in shrimp cocktail.

**Usage**

shrimp

---

**Source**


**Shuttle**  
*Space Shuttle Autolander Problem*

**Description**

The shuttle data frame has 256 rows and 7 columns. The first six columns are categorical variables giving example conditions; the seventh is the decision. The first 253 rows are the training set, the last 3 the test conditions.

**Usage**

shuttle

**Format**

This data frame contains the following factor columns:

- **stability**: stable positioning or not (stab / xstab).
- **error**: size of error (MM / SS / LX / XL).  
- **sign**: sign of error, positive or negative (pp / nn).  
- **wind**: wind sign (head / tail).  
- **magn**: wind strength (Light / Medium / Strong / Out of Range).  
- **vis**: visibility (yes / no).  
- **use**: use the autolander or not. (auto / noauto.)

**Source**


**References**


---

**Sitka**  
*Growth Curves for Sitka Spruce Trees in 1988*

**Description**

The Sitka data frame has 395 rows and 4 columns. It gives repeated measurements on the log-size of 79 Sitka spruce trees, 54 of which were grown in ozone-enriched chambers and 25 were controls. The size was measured five times in 1988, at roughly monthly intervals.
Sitka89

Usage

Sitka

Format

This data frame contains the following columns:
size measured size (height times diameter squared) of tree, on log scale.
time time of measurement in days since 1 January 1988.
tree number of tree.
treat either "ozone" for an ozone-enriched chamber or "control".

Source


References


See Also

Sitka89.

---

Sitka89

*Growth Curves for Sitka Spruce Trees in 1989*

Description

The Sitka89 data frame has 632 rows and 4 columns. It gives repeated measurements on the log-size of 79 Sitka spruce trees, 54 of which were grown in ozone-enriched chambers and 25 were controls. The size was measured eight times in 1989, at roughly monthly intervals.

Usage

Sitka89

Format

This data frame contains the following columns:
size measured size (height times diameter squared) of tree, on log scale.
time time of measurement in days since 1 January 1988.
tree number of tree.
treat either "ozone" for an ozone-enriched chamber or "control".
The Skye data frame has 23 rows and 3 columns.

This data frame contains the following columns:

A Percentage of sodium and potassium oxides.
F Percentage of iron oxide.
M Percentage of magnesium oxide.

Source


References


Examples

```r
# ternary() is from the on-line answers.
ternary <- function(X, pch = par("pch"), lcx = 1,
  add = FALSE, ord = 1:3, ...)
{
  X <- as.matrix(X)
  if(any(X < 0)) stop("X must be non-negative")
  s <- drop(X %*% rep(1, ncol(X)))
  if(any(s<=0)) stop("each row of X must have a positive sum")
  if(max(abs(s-1)) > 1e-6) {
```
snails

Snail Mortality Data

**Description**

Groups of 20 snails were held for periods of 1, 2, 3 or 4 weeks in carefully controlled conditions of temperature and relative humidity. There were two species of snail, A and B, and the experiment was designed as a 4 by 3 by 4 by 2 completely randomized design. At the end of the exposure time the snails were tested to see if they had survived; the process itself is fatal for the animals. The object of the exercise was to model the probability of survival in terms of the stimulus variables, and in particular to test for differences between species.

The data are unusual in that in most cases fatalities during the experiment were fairly small.

**Usage**

`snails`

**Format**

The data frame contains the following components:

- **Species** snail species A (1) or B (2).
- **Exposure** exposure in weeks.
- **Rel.Hum** relative humidity (4 levels).
temp  temperature, in degrees Celsius (3 levels).
Deaths number of deaths.
N  number of snails exposed.

Source
Zoology Department, The University of Adelaide.

References

---

SP500

*Returns of the Standard and Poors 500*

Description
Returns of the Standard and Poors 500 Index in the 1990’s

Usage
SP500

Format

References

---

stdres

*Extract Standardized Residuals from a Linear Model*

Description
The standardized residuals. These are normalized to unit variance, fitted including the current data point.

Usage
stdres(object)
Arguments

object any object representing a linear model.

Value

The vector of appropriately transformed residuals.

References


See Also

residuals, studres

---

steam The Saturated Steam Pressure Data

Description

Temperature and pressure in a saturated steam driven experimental device.

Usage

steam

Format

The data frame contains the following components:

Temp  temperature, in degrees Celsius.
Press  pressure, in Pascals.

Source


References

**stepAIC**  
*Choose a model by AIC in a Stepwise Algorithm*

**Description**

Performs stepwise model selection by AIC.

**Usage**

```r
stepAIC(object, scope, scale = 0,  
direction = c("both", "backward", "forward"),  
trace = 1, keep = NULL, steps = 1000, use.start = FALSE,  
k = 2, ...)```

**Arguments**

- **object**: an object representing a model of an appropriate class. This is used as the initial model in the stepwise search.
- **scope**: defines the range of models examined in the stepwise search. This should be either a single formula, or a list containing components `upper` and `lower`, both formulae. See the details for how to specify the formulae and how they are used.
- **scale**: used in the definition of the AIC statistic for selecting the models, currently only for `lm` and `aov` models (see `extractAIC` for details).
- **direction**: the mode of stepwise search, can be one of "both", "backward", or "forward", with a default of "both". If the scope argument is missing the default for direction is "backward".
- **trace**: if positive, information is printed during the running of `stepAIC`. Larger values may give more information on the fitting process.
- **keep**: a filter function whose input is a fitted model object and the associated AIC statistic, and whose output is arbitrary. Typically `keep` will select a subset of the components of the object and return them. The default is not to keep anything.
- **steps**: the maximum number of steps to be considered. The default is 1000 (essentially as many as required). It is typically used to stop the process early.
- **use.start**: if true the updated fits are done starting at the linear predictor for the currently selected model. This may speed up the iterative calculations for `glm` (and other fits), but it can also slow them down. **Not used** in R.
- **k**: the multiple of the number of degrees of freedom used for the penalty. Only $k = 2$ gives the genuine AIC: $k = \log(n)$ is sometimes referred to as BIC or SBC.
- **...**: any additional arguments to `extractAIC`. (None are currently used.)
Details

The set of models searched is determined by the scope argument. The right-hand-side of its lower component is always included in the model, and right-hand-side of the model is included in the upper component. If scope is a single formula, it specifies the upper component, and the lower model is empty. If scope is missing, the initial model is used as the upper model.

Models specified by scope can be templates to update object as used by `update.formula`.

There is a potential problem in using `glm` fits with a variable `scale`, as in that case the deviance is not simply related to the maximized log-likelihood. The `glm` method for `extractAIC` makes the appropriate adjustment for a gaussian family, but may need to be amended for other cases. (The binomial and poisson families have fixed scale by default and do not correspond to a particular maximum-likelihood problem for variable scale.)

Where a conventional deviance exists (e.g. for `lm`, `aov` and `glm` fits) this is quoted in the analysis of variance table: it is the `unscaled` deviance.

Value

The stepwise-selected model is returned, with up to two additional components. There is an "anova" component corresponding to the steps taken in the search, as well as a "keep" component if the `keep` argument was supplied in the call. The "Resid. Dev" column of the analysis of deviance table refers to a constant minus twice the maximized log likelihood: it will be a deviance only in cases where a saturated model is well-defined (thus excluding `lm`, `aov` and `survreg` fits, for example).

Note

The model fitting must apply the models to the same dataset. This may be a problem if there are missing values and an `na.action` other than `na.fail` is used (as is the default in R). We suggest you remove the missing values first.

References


See Also

`addterm`, `dropterm`, `step`

Examples

```r
quine.hi <- aov(log(Days + 2.5) ~ .^4, quine)
quine.nxt <- update(quine.hi, . ~ . - Eth:Sex:Age:Lrn)
quine.stp <- stepAIC(quine.nxt,
    scope = list(upper = ~Eth*Sex*Age*Lrn, lower = -1),
    trace = FALSE)
quine.stp$anova

cpus1 <- cpus
for(v in names(cpus)[2:7])
    cpus1[[v]] <- cut(cpus[[v]], unique(quantile(cpus[[v]])),
```
The Stormer Viscometer Data

Description

The stormer viscometer measures the viscosity of a fluid by measuring the time taken for an inner cylinder in the mechanism to perform a fixed number of revolutions in response to an actuating weight. The viscometer is calibrated by measuring the time taken with varying weights while the mechanism is suspended in fluids of accurately known viscosity. The data comes from such a calibration, and theoretical considerations suggest a nonlinear relationship between time, weight, and viscosity, of the form 

\[
\text{Time} = \frac{(B1 \times \text{Viscosity})}{(\text{Weight} - B2)} + E
\]

where B1 and B2 are unknown parameters to be estimated, and E is error.

Usage

stormer

Format

The data frame contains the following components:

- Viscosity viscosity of fluid.
- Wt actuating weight.
- Time time taken.

Source

studres

References


---

### studres

**Extract Studentized Residuals from a Linear Model**

**Description**

The Studentized residuals. Like standardized residuals, these are normalized to unit variance, but the Studentized version is fitted ignoring the current data point. (They are sometimes called jack-knifed residuals).

**Usage**

```r
studres(object)
```

**Arguments**

- `object` any object representing a linear model.

**Value**

The vector of appropriately transformed residuals.

**References**


**See Also**

`residuals`, `stdres`

---

### summary.loglm

**Summary Method Function for Objects of Class 'loglm'**

**Description**

Returns a summary list for log-linear models fitted by iterative proportional scaling using `loglm`.

**Usage**

```r
## S3 method for class 'loglm'
summary(object, fitted = FALSE, ...)
```
Arguments

object a fitted loglm model object.
fitted if TRUE return observed and expected frequencies in the result. Using fitted = TRUE may necessitate re-fitting the object.
... arguments to be passed to or from other methods.

Details

This function is a method for the generic function summary() for class "loglm". It can be invoked by calling summary(x) for an object x of the appropriate class, or directly by calling summary.loglm(x) regardless of the class of the object.

Value

a list is returned for use by print.summary.loglm. This has components

formula the formula used to produce object
tests the table of test statistics (likelihood ratio, Pearson) for the fit.
oe if fitted = TRUE, an array of the observed and expected frequencies, otherwise NULL.

References


See Also

loglm, summary

Description

Identical to summary.glm, but with three lines of additional output: the ML estimate of theta, its standard error, and twice the log-likelihood function.

Usage

## S3 method for class 'negbin'
summary(object, dispersion = 1, correlation = FALSE, ...)

---

**summary.negbin** Summary Method Function for Objects of Class 'negbin'

---

Description

Identical to summary.glm, but with three lines of additional output: the ML estimate of theta, its standard error, and twice the log-likelihood function.

Usage

## S3 method for class 'negbin'
summary(object, dispersion = 1, correlation = FALSE, ...)
summary.rlm

Arguments

  object  fitted model object of class negbin inheriting from glm and lm. Typically the output of glm.nb.
  dispersion  as for summary.glm, with a default of 1.
  correlation  as for summary.glm.
  ...  arguments passed to or from other methods.

Details

summary.glm is used to produce the majority of the output and supply the result. This function is a method for the generic function summary() for class "negbin". It can be invoked by calling summary(x) for an object x of the appropriate class, or directly by calling summary.negbin(x) regardless of the class of the object.

Value

As for summary.glm; the additional lines of output are not included in the resultant object.

Side Effects

A summary table is produced as for summary.glm, with the additional information described above.

References


See Also

summary.glm.nb, negative.binomial, anova.negbin

Examples

  summary(glm.nb(Days ~ Eth*Age*Lrn*Sex, quine, link = log))

summary.rlm  Summary Method for Robust Linear Models

Description

  summary method for objects of class "rlm"

Usage

  ## S3 method for class 'rlm'
  summary(object, method = c("XtX", "XtWX"), correlation = FALSE, ...)
Arguments

object  the fitted model. This is assumed to be the result of some fit that produces an object inheriting from the class `rlm`, in the sense that the components returned by the `rlm` function will be available.

method  Should the weighted (by the IWLS weights) or unweighted cross-products matrix be used?

correlation  logical. Should correlations be computed (and printed)?

...  arguments passed to or from other methods.

Details

This function is a method for the generic function `summary()` for class "rlm". It can be invoked by calling `summary(x)` for an object `x` of the appropriate class, or directly by calling `summary.rlm(x)` regardless of the class of the object.

Value

If printing takes place, only a null value is returned. Otherwise, a list is returned with the following components. Printing always takes place if this function is invoked automatically as a method for the `summary` function.

correlation  The computed correlation coefficient matrix for the coefficients in the model.

cov.unscaled  The unscaled covariance matrix; i.e, a matrix such that multiplying it by an estimate of the error variance produces an estimated covariance matrix for the coefficients.

sigma  The scale estimate.

stddev  A scale estimate used for the standard errors.

df  The number of degrees of freedom for the model and for residuals.

coefficients  A matrix with three columns, containing the coefficients, their standard errors and the corresponding t statistic.

terms  The terms object used in fitting this model.

References


See Also

`summary`

Examples

```r
summary(rlm(calls ~ year, data = phones, maxit = 50))
```
**Survey**

**Student Survey Data**

**Description**

This data frame contains the responses of 237 Statistics I students at the University of Adelaide to a number of questions.

**Usage**

survey

**Format**

The components of the data frame are:

- **Sex**  The sex of the student. (Factor with levels "Male" and "Female".)
- **Wr.Hnd**  span (distance from tip of thumb to tip of little finger of spread hand) of writing hand, in centimetres.
- **Nm.Hnd**  span of non-writing hand.
- **W.Hnd**  writing hand of student. (Factor, with levels "Left" and "Right".)
- **Fold**  "Fold your arms! Which is on top" (Factor, with levels "R on L", "L on R", "Neither").
- **Pulse**  pulse rate of student (beats per minute).
- **Clap**  ‘Clap your hands! Which hand is on top?’ (Factor, with levels "Right", "Left", "Neither").
- **Exer**  how often the student exercises. (Factor, with levels "Freq" (frequently), "Some", "None").
- **Smoke**  how much the student smokes. (Factor, levels "Heavy", "Regul" (regularly), "Occas" (occasionally), "Never").
- **Height**  height of the student in centimetres.
- **M.I**  whether the student expressed height in imperial (feet/inches) or metric (centimetres/metres) units. (Factor, levels "Metric", "Imperial").
- **Age**  age of the student in years.

**References**

synth.tr  

_Synthetic Classification Problem_

**Description**

The `synth.tr` data frame has 250 rows and 3 columns. The `synth.te` data frame has 100 rows and 3 columns. It is intended that `synth.tr` be used from training and `synth.te` for testing.

**Usage**

`synth.tr`  
`synth.te`

**Format**

These data frames contains the following columns:

- `xs`  x-coordinate  
- `ys` y-coordinate  
- `yc` class, coded as 0 or 1.

**Source**


theta.md  

_Estimate theta of the Negative Binomial_

**Description**

Given the estimated mean vector, estimate theta of the Negative Binomial Distribution.

**Usage**

```
theta.md(y, mu, dfr, weights, limit = 20, eps = .Machine$double.eps^0.25)
theta.ml(y, mu, n, weights, limit = 10, eps = .Machine$double.eps^0.25, 
         trace = FALSE)
theta.mm(y, mu, dfr, weights, limit = 10, eps = .Machine$double.eps^0.25)
```
Arguments

- **y** Vector of observed values from the Negative Binomial.
- **mu** Estimated mean vector.
- **n** Number of data points (defaults to the sum of weights)
- **dfr** Residual degrees of freedom (assuming theta known). For a weighted fit this is the sum of the weights minus the number of fitted parameters.
- **weights** Case weights. If missing, taken as 1.
- **limit** Limit on the number of iterations.
- **eps** Tolerance to determine convergence.
- **trace** logical: should iteration progress be printed?

Details

theta.md estimates by equating the deviance to the residual degrees of freedom, an analogue of a moment estimator.

theta.ml uses maximum likelihood.

theta.mm calculates the moment estimator of theta by equating the Pearson chi-square \( \sum (y - \mu)^2 / (\mu + \mu^2/\theta) \) to the residual degrees of freedom.

Value

The required estimate of theta, as a scalar. For theta.ml, the standard error is given as attribute "SE".

See Also
glm.nb

Examples

```r
quine.nb <- glm.nb(Days ~ .^2, data = quine)
theta.md(quine$Days, fitted(quine.nb), dfr = df.residual(quine.nb))
theta.ml(quine$Days, fitted(quine.nb))
theta.mm(quine$Days, fitted(quine.nb), dfr = df.residual(quine.nb))
```

## weighted example

```r
yeast <- data.frame(cbind(numbers = 0:5, fr = c(213, 128, 37, 18, 3, 1)))
fit <- glm.nb(numbers ~ 1, weights = fr, data = yeast)
summary(fit)
mu <- fitted(fit)
theta.md(yeast$numbers, mu, dfr = 399, weights = yeast$fr)
theta.ml(yeast$numbers, mu, limit = 15, weights = yeast$fr)
theta.mm(yeast$numbers, mu, dfr = 399, weights = yeast$fr)
```
### topo

**Spatial Topographic Data**

**Description**

The topo data frame has 52 rows and 3 columns, of topographic heights within a 310 feet square.

**Usage**

topo

**Format**

This data frame contains the following columns:

- **x** x coordinates (units of 50 feet)
- **y** y coordinates (units of 50 feet)
- **z** heights (feet)

**Source**


**References**


---

### Traffic

**Effect of Swedish Speed Limits on Accidents**

**Description**

An experiment was performed in Sweden in 1961–2 to assess the effect of a speed limit on the motorway accident rate. The experiment was conducted on 92 days in each year, matched so that day j in 1962 was comparable to day j in 1961. On some days the speed limit was in effect and enforced, while on other days there was no speed limit and cars tended to be driven faster. The speed limit days tended to be in contiguous blocks.

**Usage**

Traffic
truehist

Format

This data frame contains the following columns:

- **year**: 1961 or 1962.
- **day**: of year.
- **limit**: was there a speed limit?
- **y**: traffic accident count for that day.

Source


References


truehist

Plot a Histogram

Description

Creates a histogram on the current graphics device.

Usage

```r
truehist(data, nbins = "Scott", h, x0 = -h/1000, breaks, prob = TRUE, xlim = range(breaks), ymax = max(est), col = "cyan", xlab = deparse(substitute(data)), bty = "n", …)
```

Arguments

- **data**: numeric vector of data for histogram. Missing values (NAs) are allowed and omitted.
- **nbins**: The suggested number of bins. Either a positive integer, or a character string naming a rule: "Scott" or "Freedman-Diaconis" or "FD". (Case is ignored.)
- **h**: The bin width, a strictly positive number (takes precedence over nbins).
- **x0**: Shift for the bins - the breaks are at \( x_0 + h \ast \{\ldots, -1, 0, 1, \ldots\} \)
- **breaks**: The set of breakpoints to be used. (Usually omitted, takes precedence over h and nbins).
prob
If true (the default) plot a true histogram. The vertical axis has a relative frequency density scale, so the product of the dimensions of any panel gives the relative frequency. Hence the total area under the histogram is 1 and it is directly comparable with most other estimates of the probability density function. If false plot the counts in the bins.

xlim
The limits for the x-axis.

ymax
The upper limit for the y-axis.

col
The colour for the bar fill: the default is colour 5 in the default R palette.

xlab
label for the plot x-axis. By default, this will be the name of data.

bty
The box type for the plot - defaults to none.

... additional arguments to rect or plot.

Details
This plots a true histogram, a density estimate of total area 1. If breaks is specified, those breakpoints are used. Otherwise if h is specified, a regular grid of bins is used with width h. If neither breaks nor h is specified, nbins is used to select a suitable h.

Side Effects
A histogram is plotted on the current device.

References

See Also
hist

ucv

Unbiased Cross-Validation for Bandwidth Selection

Description
Uses unbiased cross-validation to select the bandwidth of a Gaussian kernel density estimator.

Usage
ucv(x, nb = 1000, lower, upper)

Arguments
x a numeric vector
nb number of bins to use.
lower, upper Range over which to minimize. The default is almost always satisfactory.
**UScereal**

**Value**

a bandwidth.

**References**


**See Also**

`bcv`, `width.SJ`, `density`

**Examples**

```r
ucv(geyser$duration)
```

---

**UScereal**

*Nutritional and Marketing Information on US Cereals*

**Description**

The `UScereal` data frame has 65 rows and 11 columns. The data come from the 1993 ASA Statistical Graphics Exposition, and are taken from the mandatory F&DA food label. The data have been normalized here to a portion of one American cup.

**Usage**

`UScereal`

**Format**

This data frame contains the following columns:

- `mfr`  Manufacturer, represented by its first initial: G=General Mills, K=Kelloggs, N=Nabisco, P=Post, Q=Quaker Oats, R=Ralston Purina.
- `calories`  number of calories in one portion.
- `protein`  grams of protein in one portion.
- `fat`  grams of fat in one portion.
- `sodium`  milligrams of sodium in one portion.
- `fibre`  grams of dietary fibre in one portion.
- `carbo`  grams of complex carbohydrates in one portion.
- `sugars`  grams of sugars in one portion.
- `shelf`  display shelf (1, 2, or 3, counting from the floor).
- `potassium`  grams of potassium.
- `vitamins`  vitamins and minerals (none, enriched, or 100%).
Source

The original data are available at http://lib.stat.cmu.edu/datasets/1993.expo/.

References


---

### UScrime

**The Effect of Punishment Regimes on Crime Rates**

**Description**

Criminologists are interested in the effect of punishment regimes on crime rates. This has been studied using aggregate data on 47 states of the USA for 1960 given in this data frame. The variables seem to have been re-scaled to convenient numbers.

**Usage**

`UScrime`

**Format**

This data frame contains the following columns:

- **M**: percentage of males aged 14–24.
- **So**: indicator variable for a Southern state.
- **Ed**: mean years of schooling.
- **Po1**: police expenditure in 1960.
- **Po2**: police expenditure in 1959.
- **LF**: labour force participation rate.
- **M.F**: number of males per 1000 females.
- **Pop**: state population.
- **NW**: number of non-whites per 1000 people.
- **U1**: unemployment rate of urban males 14–24.
- **U2**: unemployment rate of urban males 35–39.
- **GDP**: gross domestic product per head.
- **Ineq**: income inequality.
- **Prob**: probability of imprisonment.
- **Time**: average time served in state prisons.
- **y**: rate of crimes in a particular category per head of population.
Source


References


---

**VA**

**Veteran’s Administration Lung Cancer Trial**

Description

Veteran’s Administration lung cancer trial from Kalbfleisch & Prentice.

Usage

VA

Format

A data frame with columns:

- **stime** survival or follow-up time in days.
- **status** dead or censored.
- **treat** treatment: standard or test.
- **age** patient’s age in years.
- **karn** Karnofsky score of patient’s performance on a scale of 0 to 100.
- **diag.time** times since diagnosis in months at entry to trial.
- **cell** one of four cell types.
- **prior** prior therapy?

Source


References

Counts of Waders at 15 Sites in South Africa

Description

The `waders` data frame has 15 rows and 19 columns. The entries are counts of waders in summer.

Usage

`waders`

Format

This data frame contains the following columns (species):

- S1 Oystercatcher
- S2 White-fronted Plover
- S3 Kitt Lutz's Plover
- S4 Three-banded Plover
- S5 Grey Plover
- S6 Ringed Plover
- S7 Bar-tailed Godwit
- S8 Whimbrel
- S9 Marsh Sandpiper
- S10 Greenshank
- S11 Common Sandpiper
- S12 Turnstone
- S13 Knot
- S14 Sanderling
- S15 Little Stint
- S16 Curlew Sandpiper
- S17 Ruff
- S18 Avocet
- S19 Black-winged Stilt

The rows are the sites:

- A = Namibia North coast
- B = Namibia North wetland
- C = Namibia South coast
- D = Namibia South wetland
- E = Cape North coast
- F = Cape North wetland
G = Cape West coast
H = Cape West wetland
I = Cape South coast
J = Cape South wetland
K = Cape East coast
L = Cape East wetland
M = Transkei coast
N = Natal coast
O = Natal wetland

Source

J.C. Gower and D.J. Hand (1996) *Biplots* Chapman & Hall Table 9.1. Quoted as from:

Examples

```r
plot(corresp(waders, nf=2))
```

### whiteside

#### House Insulation: Whiteside’s Data

**Description**

Mr Derek Whiteside of the UK Building Research Station recorded the weekly gas consumption and average external temperature at his own house in south-east England for two heating seasons, one of 26 weeks before, and one of 30 weeks after cavity-wall insulation was installed. The object of the exercise was to assess the effect of the insulation on gas consumption.

**Usage**

```r
whiteside
```

**Format**

The *whiteside* data frame has 56 rows and 3 columns:

- **Insul** A factor, before or after insulation.
- **Temp** Purportedly the average outside temperature in degrees Celsius. (These values is far too low for any 56-week period in the 1960s in South-East England. It might be the weekly average of daily minima.)
- **Gas** The weekly gas consumption in 1000s of cubic feet.
Source

A data set collected in the 1960s by Mr Derek Whiteside of the UK Building Research Station. Reported by


References


Examples

```
require(lattice)
xpplot(Gas ~ Temp | Insul, whiteside, panel =
  function(x, y, ...)
  {
    panel.xpplot(x, y, ...)
    panel.mlmline(x, y, ...)
  },
  xlab = "Average external temperature (deg. C)",
ylab = "Gas consumption (1000 cubic feet)",
  aspect = "xy",
  strip = function(...)
  strip.default(..., style = 1))

gasB <- lm(Gas ~ Temp, whiteside, subset = Insul="Before")
gasA <- update(gasB, subset = Insul="After")
summary(gasB)
summary(gasA)
gasBA <- lm(Gas ~ Insul/Temp - 1, whiteside)
summary(gasBA)

gasQ <- lm(Gas ~ Insul/(Temp + I(Temp^2)) - 1, whiteside)
coef(summary(gasQ))

gasPR <- lm(Gas ~ Insul + Temp, whiteside)
anova(gasPR, gasBA)
options(contrasts = c("contr.treatment", "contr.poly"))
gasBA1 <- lm(Gas ~ Insul*Temp, whiteside)
coef(summary(gasBA1))
```

width.SJ

Bandwidth Selection by Pilot Estimation of Derivatives

Description

Uses the method of Sheather & Jones (1991) to select the bandwidth of a Gaussian kernel density estimator.

Usage

```
width.SJ(x, nb = 1000, lower, upper, method = c("ste", "dpi"))
```
write.matrix

Arguments

- **x**: a numeric vector
- **nb**: number of bins to use.
- **upper, lower**: range over which to search for solution if **method** = "ste".
- **method**: Either "ste" ("solve-the-equation") or "dpi" ("direct plug-in").

Value

A bandwidth.

Note

A faster version for large \(n\) (thousands) is available in \(R \geq 3.4.0\) as part of \(bw.JJ\): quadruple its value for comparability with this version.

References


See Also

ucv, bcv, density

Examples

```r
width.SJ(geyser$duration, method = "dpi")
width.SJ(geyser$duration)
width.SJ(galaxies, method = "dpi")
width.SJ(galaxies)
```

---

write.matrix  
*Write a Matrix or Data Frame*

Description

Writes a matrix or data frame to a file or the console, using column labels and a layout respecting columns.

Usage

```r
write.matrix(x, file = "", sep = " ", blocksize)
```
Arguments

- **x**: matrix or data frame.
- **file**: name of output file. The default (""") is the console.
- **sep**: The separator between columns.
- **blocksize**: If supplied and positive, the output is written in blocks of blocksize rows. Choose as large as possible consistent with the amount of memory available.

Details

If `x` is a matrix, supplying `blocksize` is more memory-efficient and enables larger matrices to be written, but each block of rows might be formatted slightly differently.

If `x` is a data frame, the conversion to a matrix may negate the memory saving.

Side Effects

A formatted file is produced, with column headings (if `x` has them) and columns of data.

References


See Also

- `write.table`

---

**wtloss**

*Weight Loss Data from an Obese Patient*

Description

The data frame gives the weight, in kilograms, of an obese patient at 52 time points over an 8 month period of a weight rehabilitation programme.

Usage

`wtloss`

Format

This data frame contains the following columns:

- **Days**: time in days since the start of the programme.
- **Weight**: weight in kilograms of the patient.

Source

Dr T. Davies, Adelaide.
wtloss

References


Examples

```r
wtloss.fm <- nls(Weight ~ b0 + b1*2^(Days/th),
                 data = wtloss, start = list(b0=90, b1=95, th=120))
wtloss.fm
plot(wtloss)
with(wtloss, lines(Days, fitted(wtloss.fm)))
```
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