

# Package ‘sasLM’

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**Version** 0.9.11

**Title** 'SAS' Linear Model

**Description** This is a core implementation of 'SAS' procedures for linear models - GLM, REG, ANOVA, TTEST, FREQ, and UNIVARIATE. Some R packages provide type II and type III SS. However, the results of nested and complex designs are often different from those of 'SAS.' Different results does not necessarily mean incorrectness. However, many want the same results to SAS. This package aims to achieve that.  
Reference: Littell RC, Stroup WW, Freund RJ (2002, ISBN:0-471-22174-0).

**Depends** R (>= 3.5.0), mvtnorm

**Imports** methods

**Suggests** MASS

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## R topics documented:

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sasLM-package	<i>'SAS' Linear Model</i>
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## Description

This is a core implementation of 'SAS' procedures for linear models - GLM, REG, and ANOVA. Some packages provide type II and type III SS. However, the results of nested and complex designs are often different from those of 'SAS'. A different result does not necessarily mean incorrectness. However, many want the same result with 'SAS'. This package aims to achieve that. Reference: Littell RC, Stroup WW, Freund RJ (2002, ISBN:0-471-22174-0).

## Details

This will serve those who want SAS PROC GLM, REG, and ANOVA in R.

## Author(s)

Kyun-Seop Bae k@acr.kr

## Examples

```
## SAS PROC GLM Script for Typical Bioequivalence Data
# PROC GLM DATA=BEdata;
# CLASS SEQ SUBJ PRD TRT;
# MODEL LNCMAX = SEQ SUBJ(SEQ) PRD TRT;
# RANDOM SUBJ(SEQ)/TEST;
# LSMEANS TRT / DIFF=CONTROL("R") CL ALPHA=0.1;
# ODS OUTPUT LSMeanDiffCL=LSMD;

# DATA LSMD; SET LSMD;
# PE = EXP(DIFFERENCE);
# LL = EXP(LowerCL);
# UL = EXP(UpperCL);
# PROC PRINT DATA=LSMD; RUN;
##

## SAS PROC GLM equivalent
BEdata = af(BEdata, c("SEQ", "SUBJ", "PRD", "TRT")) # Columns as factor
formula1 = log(CMAX) ~ SEQ/SUBJ + PRD + TRT # Model
GLM(formula1, BEdata) # ANOVA tables of Type I, II, III SS
RanTest(formula1, BEdata, Random="SUBJ") # Hypothesis test with SUBJ as random
ci0 = CIest(formula1, BEdata, "TRT", c(-1, 1), 0.90) # 90% CI
exp(ci0[, c("Estimate", "Lower CL", "Upper CL")]) # 90% CI of GMR

## 'nlme' or SAS PROC MIXED is preferred for an unbalanced case
## SAS PROC MIXED equivalent
# require(nlme)
# Result = lme(log(CMAX) ~ SEQ + PRD + TRT, random=~1|SUBJ, data=BEdata)
# summary(Result)
# VarCorr(Result)
# ci = intervals(Result, 0.90) ; ci
# exp(ci$fixed["TRTT",])
##
```

---

af

---

*Convert some columns of a data.frame to factors*


---

## Description

Conveniently convert some columns of data.frame into factors.

## Usage

```
af(DataFrame, Cols)
```

## Arguments

DataFrame	a data.frame
Cols	column names or indices to be converted

## Details

It performs conversion of some columns in a data.frame into factors conveniently.

**Value**

Returns a `data.frame` with converted columns.

**Author(s)**

Kyun-Seop Bae `k@acr.kr`

---

aov1	<i>ANOVA with Type I SS</i>
------	-----------------------------

---

**Description**

ANOVA with Type I SS.

**Usage**

```
aov1(Formula, Data, BETA=FALSE, Resid=FALSE)
```

**Arguments**

Formula	a conventional formula for a linear model.
Data	a <code>data.frame</code> to be analyzed
BETA	if TRUE, coefficients (parameters) of REG will be returned. This is equivalent to SOLUTION option of SAS PROC GLM
Resid	if TRUE, fitted values ( $\hat{y}$ ) and residuals will be returned

**Details**

It performs the core function of SAS PROC GLM, and returns Type I SS. This accepts continuous independent variables also.

**Value**

The result table is comparable to that of SAS PROC ANOVA.

Df	degree of freedom
Sum Sq	sum of square for the set of contrasts
Mean Sq	mean square
F value	F value for the F distribution
Pr(>F)	probability of larger than F value

Next returns are optional.

Parameter	Parameter table with standard error, t value, p value. TRUE is 1, and FALSE is 0 in the Estimable column. This is returned only with BETA=TRUE option.
Fitted	Fitted value or $\hat{y}$ . This is returned only with Resid=TRUE option.
Residual	Weighted residuals. This is returned only with Resid=TRUE option.

Author(s)

Kyun-Seop Bae k@acr.kr

Examples

```
aov1(uptake ~ Plant + Type + Treatment + conc, C02)
aov1(uptake ~ Plant + Type + Treatment + conc, C02, BETA=TRUE)
aov1(uptake ~ Plant + Type + Treatment + conc, C02, Resid=TRUE)
aov1(uptake ~ Plant + Type + Treatment + conc, C02, BETA=TRUE, Resid=TRUE)
```

---

aov2	<i>ANOVA with Type II SS</i>
------	------------------------------

---

Description

ANOVA with Type II SS.

Usage

```
aov2(Formula, Data, BETA=FALSE, Resid=FALSE)
```

Arguments

Formula	a conventional formula for a linear model.
Data	a data.frame to be analyzed
BETA	if TRUE, coefficients (parameters) of REG will be returned. This is equivalent to SOLUTION option of SAS PROC GLM
Resid	if TRUE, fitted values (y hat) and residuals will be returned

Details

It performs the core function of SAS PROC GLM, and returns Type II SS. This accepts continuous independent variables also.

Value

The result table is comparable to that of SAS PROC ANOVA.

Df	degree of freedom
Sum Sq	sum of square for the set of contrasts
Mean Sq	mean square
F value	F value for the F distribution
Pr(>F)	proability of larger than F value

Next returns are optional.

Parameter	Parameter table with standard error, t value, p value. TRUE is 1, and FALSE is 0 in the Estimable column. This is returned only with BETA=TRUE option.
Fitted	Fitted value or y hat. This is returned only with Resid=TRUE option.
Residual	Weigthted residuals. This is returned only with Resid=TRUE option.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
aov2(uptake ~ Plant + Type + Treatment + conc, C02)
aov2(uptake ~ Plant + Type + Treatment + conc, C02, BETA=TRUE)
aov2(uptake ~ Plant + Type + Treatment + conc, C02, Resid=TRUE)
aov2(uptake ~ Plant + Type + Treatment + conc, C02, BETA=TRUE, Resid=TRUE)
aov2(uptake ~ Type, C02)
aov2(uptake ~ Type - 1, C02)
```

---

aov3

---

*ANOVA with Type III SS*


---

**Description**

ANOVA with Type III SS.

**Usage**

```
aov3(Formula, Data, BETA=FALSE, Resid=FALSE)
```

**Arguments**

Formula	a conventional formula for a linear model.
Data	a data.frame to be analyzed
BETA	if TRUE, coefficients (parameters) of REG will be returned. This is equivalent to SOLUTION option of SAS PROC GLM
Resid	if TRUE, fitted values (y hat) and residuals will be returned

**Details**

It performs the core function of SAS PROC GLM, and returns Type III SS. This accepts continuous independent variables also.

**Value**

The result table is comparable to that of SAS PROC ANOVA.

Df	degree of freedom
Sum Sq	sum of square for the set of contrasts
Mean Sq	mean square
F value	F value for the F distribution
Pr(>F)	probability of larger than F value

Next returns are optional.

Parameter	Parameter table with standard error, t value, p value. TRUE is 1, and FALSE is 0 in the Estimable column. This is returned only with BETA=TRUE option.
Fitted	Fitted value or y hat. This is returned only with Resid=TRUE option.
Residual	Weighted residuals. This is returned only with Resid=TRUE option.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
aov3(uptake ~ Plant + Type + Treatment + conc, C02)
aov3(uptake ~ Plant + Type + Treatment + conc, C02, BETA=TRUE)
aov3(uptake ~ Plant + Type + Treatment + conc, C02, Resid=TRUE)
aov3(uptake ~ Plant + Type + Treatment + conc, C02, BETA=TRUE, Resid=TRUE)
```

---

aspirinCHD

*An example data for meta-analysis - aspirin in coronary heart disease*

---

**Description**

The data is from 'Canner PL. An overview of six clinical trials of aspirin in coronary heart disease. Stat Med. 1987'

**Usage**

```
aspirinCHD
```

**Format**

A data frame with 6 rows.

y1 death event count of aspirin group  
 n1 total subje of aspirin group  
 y2 death event count of placebo group  
 n2 total subject of placebo group

**Details**

This data is for educational purpose.

**References**

Canner PL. An overview of six clinical trials of aspirin in coronary heart disease. Stat Med. 1987;6:255-263.

---

BasicUtil

*Internal Functions*

---

**Description**

Internal functions

**Details**

These are not to be called by the user.



BEdata

*An Example Data of Bioequivalence Study***Description**

Contains Cmax data from a real bioequivalence study.

**Usage**

```
BEdata
```

**Format**

A data frame with 91 observations on the following 6 variables.

ADM Admission or Hospitalization Group Code: 1, 2, or 3

SEQ Group or Sequence character code: 'RT' or 'TR'

PRD Period numeric value: 1 or 2

TRT Treatment or Drug code: 'R' or 'T'

SUBJ Subject ID

CMAX Cmax values

**Details**

This contains a real data of 2x2 bioequivalence study, which has three different hospitalization groups. See Bae KS, Kang SH. Bioequivalence data analysis for the case of separate hospitalization. Transl Clin Pharmacol. 2017;25(2):93-100. doi.org/10.12793/tcp.2017.25.2.93

bk

*Beautify the output of knitr::kable***Description**

Trailing zeros after integer is somewhat annoying. This removes those in the vector of strings.

**Usage**

```
bk(ktab, rpltag=c("n", "N"), dig=10)
```

**Arguments**

ktab an output of knitr::kable

rpltag tag string of replacement rows. This is usually "n" which means the sample count.

dig maximum digits of decimals in the kable output

**Details**

This is convenient if used with tsum0, tsum1, tsum2, tsum3, This requires knitr::kable.

**Value**

A new processed vector of strings. The class is still `knitr_kable`.

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[tsum0](#), [tsum1](#), [tsum2](#), [tsum3](#)

**Examples**

```
## OUTPUT example
# t0 = tsum0(CO2, "uptake", c("mean", "median", "sd", "length", "min", "max"))
# bk(kable(t0)) # requires knitr package
#
# |          |          x|
# |:-----|-----:|
# |mean    | 27.21310|
# |median  | 28.30000|
# |sd      | 10.81441|
# |n       | 84      |
# |min     | 7.70000|
# |max     | 45.50000|

# t1 = tsum(uptake ~ Treatment, CO2,
#           e=c("mean", "median", "sd", "min", "max", "length"),
#           ou=c("chilled", "nonchilled"),
#           repl=list(c("median", "length"), c("med", "N")))
#
# bk(kable(t1, digits=3)) # requires knitr package
#
# |      | chilled| nonchilled| Combined|
# |:----|-----:|-----:|-----:|
# |mean | 23.783| 30.643| 27.213|
# |med  | 19.700| 31.300| 28.300|
# |sd   | 10.884| 9.705| 10.814|
# |min  | 7.700| 10.600| 7.700|
# |max  | 42.400| 45.500| 45.500|
# |N    | 42   | 42   | 84   |
```

---

 BY

---

*Analysis BY variable*


---

**Description**

GLM, REG, aov1 etc. functions can be run by levels of a variable.

**Usage**

```
BY(FUN, Formula, Data, By, ...)
```

**Arguments**

<code>FUN</code>	Function name to be called such as GLM, REG
<code>Formula</code>	a conventional formula for a linear model.
<code>Data</code>	a <code>data.frame</code> to be analyzed
<code>By</code>	a variable name in the Data
<code>...</code>	arguments to be passed to FUN function

**Details**

This mimics SAS procedues' BY clause.

**Value**

a list of FUN function outputs. The names are after each level.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
BY(GLM, uptake ~ Treatment + as.factor(conc), C02, By="Type")
BY(REG, uptake ~ conc, C02, By="Type")
```

---

CIest	<i>Confidence Interval Estimation</i>
-------	---------------------------------------

---

**Description**

Get point estimate and its confidence interval with given contrast and alpha value using t distribution.

**Usage**

```
CIest(Formula, Data, Term, Contrast, conf.level=0.95)
```

**Arguments**

<code>Formula</code>	a conventional formula for a linear model
<code>Data</code>	a <code>data.frame</code> to be analyzed
<code>Term</code>	a factor name to be estimated
<code>Contrast</code>	a level vector. Level is alphabetically ordered by default.
<code>conf.level</code>	confidence level of confidence interval

**Details**

Get point estimate and its confidence interval with given contrast and alpha value using t distribution.

**Value**

Estimate	point estimate of the input linear contrast
Lower CL	lower confidence limit
Upper CL	upper confidence limit
Std. Error	standard error of the point estimate
t value	value for t distribution
Df	degree of freedom
Pr(> t )	probability of larger than absolute t value from t distribution with residual's degree of freedom

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
CIest(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata, "TRT", c(-1, 1), 0.90) # 90% CI
```

---

Coll	<i>Collinearity Diagnostics</i>
------	---------------------------------

---

**Description**

Collinearity diagnostics with tolerance, VIF, eigenvalue, condition index, variance proportions

**Usage**

```
Coll(Formula, Data)
```

**Arguments**

Formula	formula of the model
Data	input data as a matrix or data.frame

**Details**

Sometimes collinearity diagnostics after multiple linear regression are necessary.

**Value**

Tol	tolerance of independent variables
VIF	variance inflation factor of independent variables
Eigenvalue	eigenvalue of $Z'Z$ (crossproduct) of standardized independent variables
Cond. Index	condition index
Proportions of variances	under the names of coefficients

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
Coll(mpg ~ disp + hp + drat + wt + qsec, mtcars)
```

---

 CONTR

*F Test with a Set of Contrasts*


---

**Description**

Do F test with a given set of contrasts.

**Usage**

```
CONTR(L, Formula, Data, mu=0)
```

**Arguments**

L	contrast matrix. Each row is a contrast.
Formula	a conventional formula for a linear model
Data	a data.frame to be analyzed
mu	a vector of mu for the hypothesis L. The length should be equal to the row count of L.

**Details**

It performs F test with a given set of contrasts (a matrix). It is similar to the CONTRAST clause of SAS PROC GLM. This can test the hypothesis that the linear combination (function)'s mean vector is mu.

**Value**

Returns sum of square and its F value and p-value.

Df	degree of freedom
Sum Sq	sum of square for the set of contrasts
Mean Sq	mean square
F value	F value for the F distribution
Pr(>F)	probability of larger than F value

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[cSS](#)

**Examples**

```
CONTR(t(c(0, -1, 1)), uptake ~ Type, CO2) # sum of square
GLM(uptake ~ Type, CO2) # compare with the above
```

---

Cor.test	<i>Correlation test of multiple numeric columns</i>
----------	---

---

**Description**

Testing correlation between numeric columns of data with Pearson method.

**Usage**

```
Cor.test(Data, conf.level=0.95)
```

**Arguments**

Data	a matrix or a data.frame
conf.level	confidence level

**Details**

It uses all numeric columns of input data. It uses "pairwise.complete.obs" rows.

**Value**

Row names show which columns are used for the test

Estimate	point estimate of correlation
Lower CL	upper confidence limit
Upper CL	lower confidence limit
t value	t value of the t distribution
Df	degree of freedom
Pr(> t )	probability with the t distribution

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
Cor.test(mtcars)
```

---

`corFisher`*Correlation test by Fisher's Z transformation*

---

**Description**

Testing correlation between two numeric vectors by Fisher's Z transformation

**Usage**

```
corFisher(x, y, conf.level=0.95, rho=0)
```

**Arguments**

<code>x</code>	the first input numeric vector
<code>y</code>	the second input numeric vector
<code>conf.level</code>	confidence level
<code>rho</code>	population correlation rho under null hypothesis

**Details**

This accepts only two numeric vectors.

**Value**

<code>N</code>	sample size, length of input vectors
<code>r</code>	sample correlation
<code>Fisher.z</code>	Fisher's z
<code>bias</code>	bias to correct
<code>rho.hat</code>	point estimate of population rho
<code>conf.level</code>	confidence level for the confidence interval
<code>lower</code>	lower limit of confidence interval
<code>upper</code>	upper limit of confidence interval
<code>rho0</code>	population correlation rho under null hypothesis
<code>p.value</code>	p value under the null hypothesis

**Author(s)**

Kyun-Seop Bae `k@acr.kr`

**References**

Fisher RA. Statistical Methods for Research Workers. 14e. 1973

**Examples**

```
corFisher(mtcars$disp, mtcars$hp, rho=0.6)
```

cSS

*Sum of Square with a Given Contrast Set***Description**

Calculates sum of squares of a contrast from a `lfit` result.

**Usage**

```
cSS(K, rx, mu=0, eps=1e-8)
```

**Arguments**

K	contrast matrix. Each row is a contrast.
rx	a result of <code>lfit</code> function
mu	a vector of mu for the hypothesis K. The length should be equal to the row count of K.
eps	Less than this value is considered as zero.

**Details**

It calculates sum of squares with given a contrast matrix and a `lfit` result. It corresponds to SAS PROC GLM CONTRAST. This can test the hypothesis that the linear combination (function)'s mean vector is mu.

**Value**

Returns sum of square and its F value and p-value.

Df	degree of freedom
Sum Sq	sum of square for the set of contrasts
Mean Sq	mean square
F value	F value for the F distribution
Pr(>F)	probability of larger than F value

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[CONTR](#)

**Examples**

```
rx = REG(uptake ~ Type, CO2, summarize=FALSE)
cSS(t(c(0, -1, 1)), rx) # sum of square
GLM(uptake ~ Type, CO2) # compare with the above
```



---

CV	<i>Coefficient of Variation in percentage</i>
----	---

---

**Description**

Coefficient of variation in percentage.

**Usage**

```
CV(y)
```

**Arguments**

y                      a numeric vector

**Details**

It removes NA.

**Value**

Coefficient of variation in percentage.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
CV(mtcars$mpg)
```

---

Diffogram	<i>Plot Pairwise Differences</i>
-----------	----------------------------------

---

**Description**

Plot pairwise differences by a common.

**Usage**

```
Diffogram(Formula, Data, Term, conf.level=0.95, adj="lsd", ...)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a data.frame to be analyzed
Term	a factor name to be estimated
conf.level	confidence level of confidence interval
adj	"lsd", "tukey", "scheffe", "bon", or "duncan" to adjust p-value and confidence limit
...	arguments to be passed to plot

**Details**

This usually shows the shortest interval. It corresponds to SAS PROC GLM PDIFF. For adjust method "dunnett", see PDIFF function.

**Value**

no return value, but a plot on the current device

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[LSM](#), [PDIFF](#)

**Examples**

```
Diffogram(uptake ~ Type*Treatment + as.factor(conc), C02, "as.factor(conc)")
```

---

DoEdata	<i>Example Datasets</i>
---------	-------------------------

---

**Description**

Contains data frames to be used for textbooks

**Details**

This contains datasets for textbooks.

---

e1	<i>Get a Contrast Matrix for Type I SS</i>
----	--

---

**Description**

Makes a contrast matrix for type I SS using forward Doolittle method.

**Usage**

```
e1(XpX, eps=1e-8)
```

**Arguments**

- |     |   |
|-----|---|
| XpX | crossprodut of a design or model matrix. This should have appropriate column names. |
| eps | Less than this value is considered as zero.   |

**Details**

It makes a contrast matrix for type I SS. If zapsmall is used, the result becomes more inaccurate.

**Value**

A contrast matrix for type I SS.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
x = ModelMatrix(uptake ~ Plant + Type + Treatment + conc, C02)
round(e1(crossprod(x$X)), 12)
```

e2

*Get a Contrast Matrix for Type II SS***Description**

Makes a contrast matrix for type II SS.

**Usage**

```
e2(x, eps=1e-8)
```

**Arguments**

x	an output of ModelMatrix
eps	Less than this value is considered as zero.

**Details**

It makes a contrast matrix for type II SS. If zapsmall is used, the result becomes more inaccurate.

**Value**

A contrast matrix for type II SS.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
round(e2(ModelMatrix(uptake ~ Plant + Type + Treatment + conc, C02)), 12)
round(e2(ModelMatrix(uptake ~ Type, C02)), 12)
round(e2(ModelMatrix(uptake ~ Type - 1, C02)), 12)
```

---

e3	<i>Get a Contrast Matrix for Type III SS</i>
----	--

---

**Description**

Makes a contrast matrix for type III SS.

**Usage**

```
e3(x, eps=1e-8)
```

**Arguments**

x	an output of ModelMatrix
eps	Less than this value is considered as zero.

**Details**

It makes a contrast matrix for type III SS. If zapsmall is used, the result becomes more inaccurate.

**Value**

A contrast matrix for type III SS.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
round(e3(ModelMatrix(uptake ~ Plant + Type + Treatment + conc, CO2)), 12)
```

---

EMS	<i>Expected Mean Square Formula</i>
-----	-------------------------------------

---

**Description**

Calculates a formula table for expected mean square of the given contrast. The default is for Type III SS.

**Usage**

```
EMS(Formula, Data, Type=3, eps=1e-8)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a data.frame to be analyzed
Type	type of sum of squares. The default is 3. Type 4 is not supported yet.
eps	Less than this value is considered as zero.

**Details**

This is necessary for further hypothesis tests of nesting factors.

**Value**

A coefficient matrix for Type III expected mean square

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
f1 = log(CMAX) ~ SEQ/SUBJ + PRD + TRT
EMS(f1, BEdata)
EMS(f1, BEdata, Type=1)
EMS(f1, BEdata, Type=2)
```

---

est	<i>Estimate Linear Functions</i>
-----	----------------------------------

---

**Description**

Estimates Linear Functions with a given GLM result.

**Usage**

```
est(L, X, rx, conf.level=0.95, adj="lsd", paired=FALSE)
```

**Arguments**

L	a matrix of linear contrast rows to be tested
X	a model (design) matrix from ModelMatrix
rx	a result of lfit function
conf.level	confidence level of confidence limit
adj	adjustment method for grouping. This supports "tukey", "bon", "scheffe", "duncan", and "dunnett". This only affects grouping, not the confidence interval.
paired	If this is TRUE, L matrix is for the pairwise comparison such as PDIFF function.

**Details**

It tests rows of linear function. Linear function means linear combination of estimated coefficients. It corresponds to SAS PROC GLM ESTIMATE. Same sample size per group is assumed for the Tukey adjustment.

Value

Estimate	point estimate of the input linear contrast
Lower CL	lower confidence limit by "lsd" method
Upper CL	upper confidence limit by "lsd" method
Std. Error	standard error of the point estimate
t value	value for t distribution for other than "scheffe" method
F value	value for F distribution for "scheffe" method only
Df	degree of freedom of residuals
Pr(> t )	probability of larger than absolute t value from t distribution with residual's degree of freedom, for other than "scheffe" method
Pr(>F)	probability of larger than F value from F distribution with residual's degree of freedom, for "scheffe" method only

Author(s)

Kyun-Seop Bae k@acr.kr

See Also

[ESTM](#), [PDIFF](#)

Examples

```
x = ModelMatrix(uptake ~ Type, C02)
rx = REG(uptake ~ Type, C02, summarize=FALSE)
est(t(c(0, -1, 1)), x$X, rx) # Quebec - Mississippi
t.test(uptake ~ Type, C02) # compare with the above
```

---

ESTM	<i>Estimate Linear Function</i>
------	---------------------------------

---

Description

Estimates Linear Function with a formula and a dataset.

Usage

```
ESTM(L, Formula, Data, conf.level=0.95)
```

Arguments

L	a matrix of linear functions rows to be tested
Formula	a conventional formula for a linear model
Data	a data.frame to be analyzed
conf.level	confidence level of confidence limit

Details

It tests rows of linear functions. Linear function means linear combination of estimated coefficients. It is similar to SAS PROC GLM ESTIMATE. This is a convenient version of est function.

Value

Estimate	point estimate of the input linear contrast
Lower CL	lower confidence limit
Upper CL	upper confidence limit
Std. Error	standard error of the point estimate
t value	value for t distribution
Df	degree of freedom
Pr(> t )	probability of larger than absolute t value from t distribution with residual's degree of freedom

Author(s)

Kyun-Seop Bae k@acr.kr

See Also

[est](#)

Examples

```
ESTM(t(c(0, -1, 1)), uptake ~ Type, CO2) # Quevec - Mississippi
```

---

estmb	<i>Estimability Check</i>
-------	---------------------------

---

Description

Check the estimability of row vectors of coefficients.

Usage

```
estmb(L, X, g2, eps=1e-8)
```

Arguments

L	row vectors of coefficients
X	a model (design) matrix from ModelMatrix
g2	g2 generalized inverse of crossprod(X)
eps	absolute value less than this is considered to be zero.

Details

It checks the estimability of L, row vectors of coefficients. This corresponds to SAS PROC GLM ESTIMATE. See <Kennedy Jr. WJ, Gentle JE. Statistical Computing. 1980> p361 or <Golub GH, Styan GP. Numerical Computations for Univariate Linear Models. 1971>.

Value

a vector of logical values indicating which row is estimable (as TRUE)

Author(s)

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

See Also

[G2SWEEP](#)

---

G2SWEEP	<i>Generalized inverse matrix of type 2, g2 inverse</i>
---------	---

---

Description

Generalized inverse is usually not unique. Some programs use this algorithm to get a unique generalized inverse matrix.

Usage

G2SWEEP(A, Augmented=FALSE, eps=1e-08)

Arguments

A	a matrix to be inverted
Augmented	If this is TRUE and A is a model(design) matrix X, the last column should be X'y, the last row y'X, and the last cell y'y. See the reference and example for the detail.
eps	Less than this value is considered as zero.

Details

Generalized inverse of g2-type is used by some softwares to do linear regression. See 'SAS Technical Report R106, The Sweep Operator: Its importance in Statistical Computing' by J. H. Goodnight for the detail.

Value

when Augmented=FALSE	ordinary g2 inverse
when Augmented=TRUE	g2 inverse and beta hats in the last column and the last row, and sum of square error (SSE) in the last cell
attribute "rank"	the rank of input matrix

Author(s)

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

See Also

[lfit](#), [ModelMatrix](#)



**Examples**

```

f1 = uptake ~ Type + Treatment # formula
x = ModelMatrix(f1, C02) # Model matrix and relevant information
y = model.frame(f1, C02)[, 1] # observation vector
nc = ncol(x$X) # number of columns of model matrix
XpY = crossprod(x$X, y)
aXpX = rbind(cbind(crossprod(x$X), XpY), cbind(t(XpY), crossprod(y)))
ag2 = G2SWEEP(aXpX, Augmented=TRUE)
b = ag2[1:nc, (nc + 1)] ; b # Beta hat
iXpX = ag2[1:nc, 1:nc] ; iXpX # g2 inverse of X'X
SSE = ag2[(nc + 1), (nc + 1)] ; SSE # Sum of Square Error
DFr = nrow(x$X) - attr(ag2, "rank") ; DFr # Degree of freedom for the residual

# Compare the below with the above
REG(f1, C02)
aov1(f1, C02)

```

geoCV

*Geometric Coefficient of Variation in percentage***Description**

Geometric coefficient of variation in percentage.

**Usage**

```
geoCV(y)
```

**Arguments**

`y` a numeric vector

**Details**

It removes NA. This is  $\sqrt{\exp(\text{var}(\log(x))) - 1} \times 100$ .

**Value**

Geometric coefficient of variation in percentage.

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[geoMean](#)

**Examples**

```
geoCV(mtcars$mpg)
```

---

geoMean	<i>Geometric Mean without NA</i>
---------	----------------------------------

---

**Description**

mean without NA values.

**Usage**

```
geoMean(y)
```

**Arguments**

y                      a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

geometric mean value

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[geoCV](#)

**Examples**

```
geoMean(mtcars$mpg)
```

---

GLM	<i>General Linear Model similar to SAS PROC GLM</i>
-----	---

---

**Description**

GLM is the main function of this package.

**Usage**

```
GLM(Formula, Data, BETA=FALSE, EMEAN=FALSE, Resid=FALSE, conf.level=0.95,  
     Weights=1)
```

**Arguments**

Formula	a conventional formula for a linear model.
Data	a <code>data.frame</code> to be analyzed
BETA	if TRUE, coefficients (parameters) of REG will be returned. This is equivalent to SOLUTION option of SAS PROC GLM
EMEAN	if TRUE, least square means (or expected means) will be returned. This is equivalent to LSMEANS clause of SAS PROC GLM
Resid	if TRUE, fitted values ( $\hat{y}$ ) and residuals will be returned
conf.level	confidence level for the confidence limit of the least square mean
Weights	weights for the weighted least square

**Details**

It performs the core function of SAS PROC GLM. Least square means for the interaction term of three variables is not supported yet.

**Value**

The result is comparable to that of SAS PROC GLM.

ANOVA	ANOVA table for the model
Fitness	Some measures of goodness of fit such as R-square and CV
Type I	Type I sum of square table
Type II	Type II sum of square table
Type III	Type III sum of square table
Parameter	Parameter table with standard error, t value, p value. TRUE is 1, and FALSE is 0 in the Estimable column. This is returned only with BETA=TRUE option.
Expected Mean	Least square (or expected) mean table with confidence limit. This is returned only with EMEAN=TRUE option.
Fitted	Fitted value or $\hat{y}$ . This is returned only with Resid=TRUE option.
Residual	Weighted residuals. This is returned only with Resid=TRUE option.

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**Examples**

```
GLM(uptake ~ Type*Treatment + conc, CO2[-1,]) # Making data unbalanced
GLM(uptake ~ Type*Treatment + conc, CO2[-1,], BETA=TRUE)
GLM(uptake ~ Type*Treatment + conc, CO2[-1,], EMEAN=TRUE)
GLM(uptake ~ Type*Treatment + conc, CO2[-1,], Resid=TRUE)
GLM(uptake ~ Type*Treatment + conc, CO2[-1,], BETA=TRUE, EMEAN=TRUE)
GLM(uptake ~ Type*Treatment + conc, CO2[-1,], BETA=TRUE, EMEAN=TRUE, Resid=TRUE)
```

---

<code>is.cor</code>	<i>Is it a correlation matrix?</i>
---------------------	------------------------------------

---

**Description**

Testing if the input matrix is a correlation matrix or not

**Usage**

```
is.cor(m, eps=1e-16)
```

**Arguments**

<code>m</code>	a presumed correlation matrix
<code>eps</code>	epsilon value. An absolute value less than this is considered as zero.

**Details**

A diagonal component should not be necessarily 1. But it should be close to 1.

**Value**

TRUE or FALSE

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

Kurtosis	<i>Kurtosis</i>
----------	-----------------

---

**Description**

Kurtosis with a conventional formula.

**Usage**

```
Kurtosis(y)
```

**Arguments**

<code>y</code>	a vector of numerics
----------------	----------------------

**Details**

It removes NA in the input vector.

**Value**

Estimate of kurtosis

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[KurtosisSE](#)

---

KurtosisSE	<i>Standard Error of Kurtosis</i>
------------	-----------------------------------

---

**Description**

Standard error of the estimated kurtosis with a conventional formula.

**Usage**

```
KurtosisSE(y)
```

**Arguments**

y                      a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

Standard error of the estimated kurtosis

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[Kurtosis](#)

---

LCL	<i>Lower Confidence Limit</i>
-----	-------------------------------

---

**Description**

The estimate of the lower bound of confidence limit using t-distribution

**Usage**

```
LCL(y, conf.level=0.95)
```

**Arguments**

y	a vector of numerics
conf.level	confidence level

**Details**

It removes NA in the input vector.

**Value**

The estimate of the lower bound of confidence limit using t-distribution

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[UCL](#)

---

lfit	<i>Linear Fit</i>
------	-------------------

---

**Description**

Fits a least square linear model.

**Usage**

```
lfit(x, y, eps=1e-8)
```

**Arguments**

x	a result of ModelMatrix
y	a column vector of response, dependent variable
eps	Less than this value is considered as zero.

**Details**

Minimum version of least square fit of a linear model

**Value**

coefficients	beta coefficients
g2	g2 inverse
rank	rank of the model matrix
DFr	degree of freedom for the residual
SSE	sum of squares error
SST	sum of squares total
DFr2	degree of freedom of the residual for beta coefficient

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[ModelMatrix](#)

**Examples**

```
f1 = uptake ~ Type*Treatment + conc
x = ModelMatrix(f1, C02)
y = model.frame(f1, C02)[,1]
lfit(x, y)
```

---

lr

---

*Linear Regression with g2 inverse*


---

**Description**

Coefficients calculated with g2 inverse. Output is similar to `summary(lm())`.

**Usage**

```
lr(Formula, Data, eps=1e-8)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a <code>data.frame</code> to be analyzed
eps	Less than this value is considered as zero.

**Details**

It uses G2SWEEP to get g2 inverse. The result is similar to `summary(lm())` without options.

**Value**

The result is comparable to that of SAS PROC REG.

Estimate	point estimate of parameters, coefficients
Std. Error	standard error of the point estimate
t value	value for t distribution
Pr(> t )	probability of larger than absolute t value from t distribution with residual's degree of freedom

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
lr(uptake ~ Plant + Type + Treatment + conc, C02)
lr(uptake ~ Plant + Type + Treatment + conc - 1, C02)
lr(uptake ~ Type, C02)
lr(uptake ~ Type - 1, C02)
```

---

 lr0

---

*Simple Linear Regressions with Each Independent Variable*


---

**Description**

Usually, the first step to multiple linear regression is simple linear regressions with a single independent variable.

**Usage**

```
lr0(Formula, Data)
```

**Arguments**

Formula	a conventional formula for a linear model. Intercept will always be added.
Data	a <code>data.frame</code> to be analyzed

**Details**

It performs simple linear regression for each independent variable.

**Value**

Each row means one simple linear regression with that row name as the only independent variable.

Intercept	estimate of the intecept
SE(Intercept)	standard error of the intercept
Slope	estimate of the slope
SE(Slope)	standard error of the slope
Rsq	R-squared for the simple linear model
Pr(>F)	p-value of slope or the model



**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
lr0(uptake ~ Plant + Type + Treatment + conc, C02)
lr0(mpg ~ ., mtcars)
```

---

LSM	<i>Least Square Means</i>
-----	---------------------------

---

**Description**

Estimates least square means using g2 inverse.

**Usage**

```
LSM(Formula, Data, Term, conf.level=0.95, adj="lsd", hideNonEst=TRUE,
    PLOT=FALSE, descend=FALSE, ...)
```

**Arguments**

Formula	a conventional formula of model
Data	data.frame
Term	term name to be returned. If there is only one independent variable, this can be omitted.
conf.level	confidence level for the confidence limit
adj	adjustment method for grouping, "lsd"(default), "tukey", "bon", "duncan", "scheffe" are available. This does not affects SE, Lower CL, Upper CL of the output table.
hideNonEst	logical. hide non-estimables
PLOT	logical. whether to plot LSMs and their confidence intervals
descend	logical. This specifies the plotting order be ascending or descending.
...	arguments to be passed to plot

**Details**

It corresponds to SAS PROC GLM LSMEANS. The result of the second example below may be different from emmeans. This is because SAS or this function calculates mean of the transformed continuous variable. However, emmeans calculates the average before the transformation. Interaction of three variables is not supported yet. For adjust method "dunnett", see PDIFF function.

**Value**

Returns a table of expectations, t values and p-values.

Group	group character. This appears with one-way ANOVA or Term or adj argument is provided.
LSmean	point estimate of least square mean
LowerCL	lower confidence limit with the given confidence level by "lsd" method

UpperCL	upper confidence limit with the given confidence level by "lsd" method
SE	standard error of the point estimate
Df	degree of freedom of point estimate

Author(s)

Kyun-Seop Bae k@acr.kr

See Also

[PDIFF](#), [Diffogram](#)

Examples

```
LSM(uptake ~ Type, C02[-1,])
LSM(uptake ~ Type - 1, C02[-1,])
LSM(uptake ~ Type*Treatment + conc, C02[-1,])
LSM(uptake ~ Type*Treatment + conc - 1, C02[-1,])
LSM(log(uptake) ~ Type*Treatment + log(conc), C02[-1,])
LSM(log(uptake) ~ Type*Treatment + log(conc) - 1, C02[-1,])
LSM(log(uptake) ~ Type*Treatment + as.factor(conc), C02[-1,])
LSM(log(uptake) ~ Type*Treatment + as.factor(conc) - 1, C02[-1,])
LSM(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata)
LSM(log(CMAX) ~ SEQ/SUBJ + PRD + TRT - 1, BEdata)
```

---

Max	<i>Max without NA</i>
-----	-----------------------

---

Description

maximum without NA values.

Usage

```
Max(y)
```

Arguments

y                      a vector of numerics

Details

It removes NA in the input vector.

Value

maximum value

Author(s)

Kyun-Seop Bae k@acr.kr

---

Mean	<i>Mean without NA</i>
------	------------------------

---

**Description**

mean without NA values.

**Usage**

```
Mean(y)
```

**Arguments**

`y` a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

mean value

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

Median	<i>Median without NA</i>
--------	--------------------------

---

**Description**

median without NA values.

**Usage**

```
Median(y)
```

**Arguments**

`y` a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

median value

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

Min	<i>Min without NA</i>
-----	-----------------------

---

**Description**

minimum without NA values.

**Usage**

```
Min(y)
```

**Arguments**

y                      a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

minimum value

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

ModelMatrix	<i>Model Matrix</i>
-------------	---------------------

---

**Description**

This model matrix is similar to `model.matrix`. But it does not omit unnecessary columns.

**Usage**

```
ModelMatrix(Formula, Data, KeepOrder=FALSE, XpX=FALSE)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a <code>data.frame</code> to be analyzed
KeepOrder	If <code>KeepOrder</code> is TRUE, terms in <code>Formula</code> will be kept. This is for Type I SS.
XpX	If <code>XpX</code> is TRUE, the cross-product of the design matrix ( $XpX$ , $X'X$ ) will be returned instead of the design matrix ( $X$ ).

**Details**

It makes the `model(design)` matrix for GLM.

**Value**

Model matrix and attributes similar to the output of `model.matrix`.

<code>X</code>	design matrix, i.e. model matrix
<code>XpX</code>	cross-product of the design matrix, $X'X$
<code>terms</code>	detailed information about terms such as formula and labels
<code>termsIndices</code>	term indices
<code>assign</code>	assignment of columns for each term in order, different way of expressing term indices

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

---

<code>mtest</code>	<i>Independent two groups t-test similar to PROC TTEST with summarized input</i>
--------------------	--

---

**Description**

This is comparable to SAS PROC TTEST except using summarized input (sufficient statistics).

**Usage**

```
mtest(m1, s1, n1, m0, s0, n0, conf.level=0.95)
```

**Arguments**

<code>m1</code>	mean of the first (test, active, experimental) group
<code>s1</code>	sample standard deviation of the first group
<code>n1</code>	sample size of the first group
<code>m0</code>	mean of the second (reference, control, placebo) group
<code>s0</code>	sample standard deviation of the second group
<code>n0</code>	sample size of the second group
<code>conf.level</code>	confidence level

**Details**

This uses summarized input. This also produces confidence intervals of means and variances by group.

**Value**

The output format is comparable to SAS PROC TTEST.

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

See Also

[TTEST](#), [tptest](#), [ztest](#)

Examples

```
mtest(5.4, 10.5, 3529, 5.1, 8.9, 5190) # NEJM 388;15 p1386
```

---

N	<i>Number of observations</i>
---	-------------------------------

---

Description

Number of observations excluding NA values

Usage

```
N(y)
```

Arguments

y                      a vector of numerics

Details

It removes NA in the input vector.

Value

Count of the observation

Author(s)

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

---

OR	<i>Odds Ratio of two groups</i>
----	---------------------------------

---

Description

Odds Ratio between two groups

Usage

```
OR(y1, n1, y2, n2, conf.level=0.95)
```

**Arguments**

y1	positive event count of test (the first) group
n1	total count of the test (the first) group
y2	positive event count of control (the second) group
n2	total count of control (the second) group
conf.level	confidence level

**Details**

It calculates odds ratio of two groups. No continuity correction here. If you need percent scale, multiply the output by 100.

**Value**

The result is a data.frame.

odd1	proportion from the first group
odd2	proportion from the second group
OR	odds ratio, odd1/odd2
SElog	standard error of log(OR)
lower	lower confidence limit of OR
upper	upper confidence limit of OR

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[RD](#), [RR](#), [RDmn1](#), [RRmn1](#), [ORmn1](#), [RDmn](#), [RRmn](#), [ORmn](#)

**Examples**

```
OR(104, 11037, 189, 11034) # no continuity correction
```

---

ORcmh

*Odds Ratio of two groups with strata by CMH method*


---

**Description**

Odds ratio and its score confidence interval of two groups with stratification by Cochran-Mantel-Haenszel method

**Usage**

```
ORcmh(d0, conf.level=0.95)
```

**Arguments**

<code>d0</code>	A data.frame or matrix, of which each row means a strata. This should have four columns named <code>y1</code> , <code>n1</code> , <code>y2</code> , and <code>n2</code> ; <code>y1</code> and <code>y2</code> for events of each group, <code>n1</code> and <code>n2</code> for sample size of each strata. The second group is usually the control group.
<code>conf.level</code>	confidence level

**Details**

It calculates odds ratio and its score confidence interval of two groups. This can be used for meta-analysis also.

**Value**

The following output will be returned for each stratum and common value. There is no standard error.

<code>odd1</code>	odd from the first group, $y1/(n1 - y1)$
<code>odd2</code>	odd from the second group, $y2/(n2 - y2)$
<code>OR</code>	odds ratio, <code>odd1/odd2</code> . The point estimate of common OR is calculated with MH weight.
<code>lower</code>	lower confidence limit of OR
<code>upper</code>	upper confidence limit of OR

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[RDmn1](#), [RRmn1](#), [ORmn1](#), [RDmn](#), [RRmn](#), [ORmn](#), [RDinv](#), [RRinv](#), [ORinv](#)

**Examples**

```
d1 = matrix(c(25, 339, 28, 335, 23, 370, 40, 364), nrow=2, byrow=TRUE)
colnames(d1) = c("y1", "n1", "y2", "n2")
ORcmh(d1)
```

---

ORinv

*Odds Ratio of two groups with strata by inverse variance method*


---

**Description**

Odds ratio and its score confidence interval of two groups with stratification by inverse variance method

**Usage**

```
ORinv(d0, conf.level=0.95)
```



**Arguments**

<code>d0</code>	A data.frame or matrix, of which each row means a stratum. This should have four columns named y1, n1, y2, and n2; y1 and y2 for events of each group, n1 and n2 for sample size of each strata. The second group is usually the control group.
<code>conf.level</code>	confidence level

**Details**

It calculates odds ratio and its confidence interval of two groups by inverse variance method. This supports stratification. This can be used for meta-analysis also.

**Value**

The following output will be returned for each stratum and common value. There is no standard error.

<code>odd1</code>	odd from the first group, $y1/(n1 - y1)$
<code>odd2</code>	odd from the second group, $y2/(n2 - y2)$
<code>OR</code>	odds ratio, $odd1/odd2$ . The point estimate of common OR is calculated with MH weight.
<code>lower</code>	lower confidence limit of OR
<code>upper</code>	upper confidence limit of OR

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[RDMn1](#), [RRmn1](#), [ORMn1](#), [RDmn](#), [RRmn](#), [ORMn](#), [RDinv](#), [RRinv](#), [ORcmh](#)

**Examples**

```
d1 = matrix(c(25, 339, 28, 335, 23, 370, 40, 364), nrow=2, byrow=TRUE)
colnames(d1) = c("y1", "n1", "y2", "n2")
ORinv(d1)
```

---

ORmn

---

*Odds Ratio and Score CI of two groups with strata by MN method*


---

**Description**

Odds ratio and its score confidence interval of two groups with stratification by the Miettinen and Nurminen method

**Usage**

```
ORMn(d0, conf.level=0.95, eps=1e-8)
```

**Arguments**

<code>d0</code>	A data.frame or matrix, of which each row means a strata. This should have four columns named <code>y1</code> , <code>n1</code> , <code>y2</code> , and <code>n2</code> ; <code>y1</code> and <code>y2</code> for events of each group, <code>n1</code> and <code>n2</code> for sample size of each strata. The second group is usually the control group.
<code>conf.level</code>	confidence level
<code>eps</code>	absolute value less than <code>eps</code> is regarded as negligible

**Details**

It calculates odds ratio and its score confidence interval of the two groups. The confidence interval is asymmetric, and there is no standard error in the output. This supports stratification. This implementation uses `uniroot` function, which usually gives at least 5 significant digits. Whereas `PropCIs::orscoreci` function uses incremental or decremental search by the factor of 1.001 which gives only about 3 significant digits. This can be used for meta-analysis also.

**Value**

The following output will be returned for each stratum and common value. There is no standard error.

<code>odd1</code>	odd from the first group, $y1/(n1 - y1)$
<code>odd2</code>	odd from the second group, $y2/(n2 - y2)$
<code>OR</code>	odds ratio, <code>odd1/odd2</code> . The point estimate of common OR is calculated with MN weight.
<code>lower</code>	lower confidence limit of OR
<code>upper</code>	upper confidence limit of OR

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**References**

Miettinen O, Nurminen M. Comparative analysis of two rates. *Stat Med* 1985;4:213-26

**See Also**

[RDmn1](#), [RRmn1](#), [ORmn1](#), [RDmn](#), [RRmn](#), [RDinv](#), [RRinv](#), [ORinv](#), [ORcmh](#)

**Examples**

```
d1 = matrix(c(25, 339, 28, 335, 23, 370, 40, 364), nrow=2, byrow=TRUE)
colnames(d1) = c("y1", "n1", "y2", "n2")
ORmn(d1)
```

---

ORmn1	<i>Odds Ratio and Score CI of two groups without strata by the MN method</i>
-------	--

---

**Description**

Odds ratio and its score confidence interval of two groups without stratification

**Usage**

```
ORmn1(y1, n1, y2, n2, conf.level=0.95, eps=1e-8)
```

**Arguments**

y1	positive event count of test (the first) group
n1	total count of the test (the first) group
y2	positive event count of control (the second) group
n2	total count of control (the second) group
conf.level	confidence level
eps	absolute value less than eps is regarded as negligible

**Details**

It calculates odds ratio and its score confidence interval of the two groups. The confidence interval is asymmetric, and there is no standard error in the output. This does not support stratification. This implementation uses uniroot function, which usually gives at least 5 significant digits. Whereas PropCIs::orscoreci function uses incremental or decremental search by the factor of 1.001 which gives only less than 3 significant digits.

**Value**

There is no standard error.

odd1	odd from the first group, $y1/(n1 - y1)$
odd2	odd from the second group, $y2/(n2 - y2)$
OR	odds ratio, odd1/odd2
lower	lower confidence limit of OR
upper	upper confidence limit of OR

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**References**

Miettinen O, Nurminen M. Comparative analysis of two rates. Stat Med 1985;4:213-26

**See Also**

[RDmn1](#), [RRmn1](#), [RDmn](#), [RRmn](#), [ORmn](#)

**Examples**

```
ORmn1(104, 11037, 189, 11034)
```

---

pB

---

*Plot Confidence and Prediction Bands for Simple Linear Regression*


---

**Description**

It plots bands of the confidence interval and prediction interval for simple linear regression.

**Usage**

```
pB(Formula, Data, Resol=300, conf.level=0.95, lx, ly, ...)
```

**Arguments**

Formula	a formula
Data	a data.frame
Resol	resolution for the output
conf.level	confidence level
lx	x position of legend
ly	y position of legend
...	arguments to be passed to plot

**Details**

It plots. Discard return values. If lx or ly is missing, the legend position is calculated automatically.

**Value**

Ignore return values.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
pB(hp ~ disp, mtcars)
pB(mpg ~ disp, mtcars)
```

---

`Pcor.test`*Partial Correlation test of multiple columns*

---

**Description**

Testing partial correlation between many columns of data with Pearson method.

**Usage**

```
Pcor.test(Data, x, y)
```

**Arguments**

<code>Data</code>	a numeric matrix or data.frame
<code>x</code>	names of columns to be tested
<code>y</code>	names of control columns

**Details**

It performs multiple partial correlation test. It uses "complete.obs" rows of x and y columns.

**Value**

Row names show which columns are used for the test

<code>Estimate</code>	point estimate of correlation
<code>Df</code>	degree of freedom
<code>t value</code>	t value of the t distribution
<code>Pr(&gt; t )</code>	probability with the t distribution

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**Examples**

```
Pcor.test(mtcars, c("mpg", "hp", "qsec"), c("drat", "wt"))
```

---

pD	<i>Diagnostic Plot for Regression</i>
----	---------------------------------------

---

**Description**

Four standard diagnostic plots for regression.

**Usage**

```
pD(rx, Title=NULL)
```

**Arguments**

rx	a result of lm, which can give fitted, residuals, and rstandard.
Title	title to be printed on the plot

**Details**

Most frequently used diagnostic plots are 'observed vs. fitted', 'standardized residual vs. fitted', 'distribution plot of standard residuals', and 'Q-Q plot of standardized residuals'.

**Value**

Four diagnostic plots in a page.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
pD(lm(uptake ~ Plant + Type + Treatment + conc, C02), "Diagnostic Plot")
```

---

PDIFF	<i>Pairwise Difference</i>
-------	----------------------------

---

**Description**

Estimates pairwise differences by a common method.

**Usage**

```
PDIFF(Formula, Data, Term, conf.level=0.95, adj="lsd", ref, PLOT=FALSE,
       reverse=FALSE, ...)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a <code>data.frame</code> to be analyzed
Term	a factor name to be estimated
conf.level	confidence level of confidence interval
adj	"lsd", "tukey", "scheffe", "bon", "duncan", or "dunnett" to adjust p-value and confidence limit
ref	reference or control level for Dunnett test
PLOT	whether to plot or not the diffogram
reverse	reverse A - B to B - A
...	arguments to be passed to plot

**Details**

It corresponds to PDIFF option of SAS PROC GLM.

**Value**

Returns a table of expectations, t values and p-values. Output columns may vary according to the adjustment option.

Estimate	point estimate of the input linear contrast
Lower CL	lower confidence limit
Upper CL	upper confidence limit
Std. Error	standard error of the point estimate
t value	value for t distribution
Df	degree of freedom
Pr(> t )	probability of larger than absolute t value from t distribution with residual's degree of freedom

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[LSM](#), [Diffogram](#)

**Examples**

```
PDIFF(uptake ~ Type*Treatment + as.factor(conc), C02, "as.factor(conc)")
PDIFF(uptake ~ Type*Treatment + as.factor(conc), C02, "as.factor(conc)", adj="tukey")
```

---

pResD	<i>Residual Diagnostic Plot for Regression</i>
-------	--

---

**Description**

Nine residual diagnostics plots.

**Usage**

```
pResD(rx, Title=NULL)
```

**Arguments**

rx	a result of lm, which can give fitted, residuals, and rstandard.
Title	title to be printed on the plot

**Details**

SAS-style residual diagnostic plots.

**Value**

Nine residual diagnostic plots in a page.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
pResD(lm(uptake ~ Plant + Type + Treatment + conc, C02), "Residual Diagnostic Plot")
```

---

QuartileRange	<i>Inter-Quartile Range</i>
---------------	-----------------------------

---

**Description**

Interquartile range (Q3 - Q1) with a conventional formula.

**Usage**

```
QuartileRange(y, Type=2)
```

**Arguments**

y	a vector of numerics
Type	a type specifier to be passed to IQR function

**Details**

It removes NA in the input vector. Type 2 is SAS default, while Type 6 is SPSS default.



**Value**

The value of an interquartile range

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

Range	<i>Range</i>
-------	--------------

---

**Description**

The range, maximum - minimum, as a scalar value.

**Usage**

Range(y)

**Arguments**

y                      a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

A scalar value of a range

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

RanTest	<i>Test with Random Effects</i>
---------	---------------------------------

---

**Description**

Hypothesis test of with specified type SS using random effects as error terms. This corresponds to SAS PROC GLM's RANDOM /TEST clause.

**Usage**

RanTest(Formula, Data, Random="", Type=3, eps=1e-8)

**Arguments**

Formula	a conventional formula for a linear model
Data	a <code>data.frame</code> to be analyzed
Random	a vector of random effects. All should be specified as primary terms, not as interaction terms. All interaction terms with random factor are regarded as random effects.
Type	Sum of square type to be used as contrast
eps	Less than this value is considered as zero.

**Details**

Type can be from 1 to 3. All interaction terms with random factor are regarded as random effects. Here the error term should not be MSE.

**Value**

Returns ANOVA and E(MS) tables with specified type SS.

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**Examples**

```
RanTest(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata, Random="SUBJ")
fBE = log(CMAX) ~ ADM/SEQ/SUBJ + PRD + TRT
RanTest(fBE, BEdata, Random=c("ADM", "SUBJ"))
RanTest(fBE, BEdata, Random=c("ADM", "SUBJ"), Type=2)
RanTest(fBE, BEdata, Random=c("ADM", "SUBJ"), Type=1)
```

---

RD

*Risk Difference between two groups*


---

**Description**

Risk (proportion) difference between two groups

**Usage**

```
RD(y1, n1, y2, n2, conf.level=0.95)
```

**Arguments**

y1	positive event count of test (the first) group
n1	total count of the test (the first) group
y2	positive event count of control (the second) group
n2	total count of control (the second) group
conf.level	confidence level

**Details**

It calculates risk difference between the two groups. No continuity correction here. If you need percent scale, multiply the output by 100.

**Value**

The result is a data.frame.

p1	proportion from the first group
p2	proportion from the second group
RD	risk difference, $p1 - p2$
SE	standard error of RD
lower	lower confidence limit of RD
upper	upper confidence limit of RD

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[RR](#), [OR](#), [RDmn1](#), [RRmn1](#), [ORmn1](#), [RDmn](#), [RRmn](#), [ORmn](#)

**Examples**

```
RD(104, 11037, 189, 11034) # no continuity correction
```

---

RDinv	<i>Risk Difference between two groups with strata by inverse variance method</i>
-------	--

---

**Description**

Risk difference and its score confidence interval between two groups with stratification by inverse variance method

**Usage**

```
RDinv(d0, conf.level=0.95)
```

**Arguments**

d0	A data.frame or matrix, of which each row means a stratum. This should have four columns named y1, n1, y2, and n2; y1 and y2 for events of each group, n1 and n2 for the sample size of each stratum. The second group is usually the control group.
conf.level	confidence level

## Details

It calculates risk difference and its confidence interval between two groups by inverse variance method. If you need percent scale, multiply the output by 100. This supports stratification. This can be used for meta-analysis also.

## Value

The following output will be returned for each stratum and common value. There is no standard error.

p1	proportion from the first group, $y1/n1$
p2	proportion from the second group, $y2/n2$
RD	risk difference, $p1 - p2$ . The point estimate of common RD is calculated with MH weight.
lower	lower confidence limit of RD
upper	upper confidence limit of RD

## Author(s)

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

## See Also

[RDmn1](#), [RRmn1](#), [ORMn1](#), [RDmn](#), [RRmn](#), [ORMn](#), [RRinv](#), [ORinv](#), [ORcmh](#)

## Examples

```
d1 = matrix(c(25, 339, 28, 335, 23, 370, 40, 364), nrow=2, byrow=TRUE)
colnames(d1) = c("y1", "n1", "y2", "n2")
RDinv(d1)
```

---

RDmn	<i>Risk Difference and Score CI between two groups with strata by the MN method</i>
------	---

---

## Description

Risk difference and its score confidence interval between two groups with stratification by the Mi-ettinen and Nurminen method

## Usage

```
RDmn(d0, conf.level=0.95, eps=1e-8)
```

## Arguments

d0	A data.frame or matrix, of which each row means a stratum. This should have four columns named y1, n1, y2, and n2; y1 and y2 for events of each group, n1 and n2 for sample size of each stratum. The second group is usually the control group. Maximum allowable value for n1 and n2 is 1e8.
conf.level	confidence level
eps	absolute value less than eps is regarded as negligible

## Details

It calculates risk difference and its score confidence interval between the two groups. The confidence interval is asymmetric, and there is no standard error in the output. If you need percent scale, multiply the output by 100. This supports stratification. This implementation uses uniroot function which usually gives at least 5 significant digits. This can be used for meta-analysis also.

## Value

The following output will be returned for each stratum and common value. There is no standard error.

p1	proportion from the first group, $y1/n1$
p2	proportion from the second group, $y2/n2$
RD	risk difference, $p1 - p2$ . The point estimate of common RD is calculated with MN weight.
lower	lower confidence limit of RD
upper	upper confidence limit of RD

## Author(s)

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

## References

Miettinen O, Nurminen M. Comparative analysis of two rates. Stat Med 1985;4:213-26

## See Also

[RDmn1](#), [RRmn1](#), [ORMn1](#), [RRmn](#), [ORMn](#), [RDinv](#), [RRinv](#), [ORinv](#), [ORcmh](#)

## Examples

```
d1 = matrix(c(25, 339, 28, 335, 23, 370, 40, 364), nrow=2, byrow=TRUE)
colnames(d1) = c("y1", "n1", "y2", "n2")
RDmn(d1)
```

---

RDmn1

*Risk Difference and Score CI between two groups without strata by the MN method*

---

## Description

Risk difference and its score confidence interval between two groups without stratification

## Usage

```
RDmn1(y1, n1, y2, n2, conf.level=0.95, eps=1e-8)
```

**Arguments**

y1	positive event count of test (the first) group
n1	total count of the test (the first) group. Maximum allowable value is 1e8.
y2	positive event count of control (the second) group
n2	total count of control (the second) group. Maximum allowable value is 1e8.
conf.level	confidence level
eps	absolute value less than eps is regarded as negligible

**Details**

It calculates risk difference and its score confidence interval between the two groups. The confidence interval is asymmetric, and there is no standard error in the output. If you need percent scale, multiply the output by 100. This does not support stratification. This implementation uses uniroot function which usually gives at least 5 significant digits.

**Value**

There is no standard error.

p1	proportion from the first group, $y1/n1$
p2	proportion from the second group, $y2/n2$
RD	risk difference, $p1 - p2$
lower	lower confidence limit of RD
upper	upper confidence limit of RD

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**References**

Miettinen O, Nurminen M. Comparative analysis of two rates. Stat Med 1985;4:213-26

**See Also**

[RRmn1](#), [ORmn1](#), [RDmn](#), [RRmn](#), [ORmn](#)

**Examples**

```
RDmn1(104, 11037, 189, 11034)
```

REG

*Regression of Linear Least Square, similar to SAS PROC REG***Description**

REG is similar to SAS PROC REG.

**Usage**

```
REG(Formula, Data, conf.level=0.95, HC=FALSE, Resid=FALSE, Weights=1,
    summarize=TRUE)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a data.frame to be analyzed
conf.level	confidence level for the confidence limit
HC	heteroscedasticity related output is required such as HC0, HC3, White's first and second moment specification test
Resid	if TRUE, fitted values ( $\hat{y}$ ) and residuals will be returned
Weights	weights for each observation or residual square. This is usually the inverse of each variance.
summarize	If this is FALSE, REG returns just lfit result.

**Details**

It performs the core function of SAS PROC REG.

**Value**

The result is comparable to that of SAS PROC REG.

The first part is ANOVA table.

The second part is measures about fitness.

The third part is the estimates of coefficients.

Estimate	point estimate of parameters, coefficients
Estimable	estimability: 1=TRUE, 0=FALSE. This appears only when at least one inestimability occurs.
Std. Error	standard error of the point estimate
Lower CL	lower confidence limit with conf.level
Upper CL	lower confidence limit with conf.level
Df	degree of freedom
t value	value for t distribution
Pr(> t )	probability of larger than absolute t value from t distribution with residual's degree of freedom

The above result is repeated using HC0 and HC3, with following White’s first and second moment specification test, if HC option is specified. The t values and their p values with HC1 and HC2 are between those of HC0 and H3.

Fitted                      Fitted value or y hat. This is returned only with Resid=TRUE option.  
Residual                    Weighted residuals. This is returned only with Resid=TRUE option.

If summarize=FALSE, REG returns;

coefficients            beta coefficients  
g2                        g2 inverse  
rank                     rank of the model matrix  
DFr                      degree of freedom for the residual  
SSE                      sum of square error

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[lr](#)

**Examples**

```
REG(uptake ~ Plant + Type + Treatment + conc, C02)
REG(uptake ~ conc, C02, HC=TRUE)
REG(uptake ~ conc, C02, Resid=TRUE)
REG(uptake ~ conc, C02, HC=TRUE, Resid=TRUE)
REG(uptake ~ conc, C02, summarize=FALSE)
```

---

regD	<i>Regression of Conventional Way with Rich Diagnostics</i>
------	---

---

**Description**

regD provides rich diagnostics such as student residual, leverage(hat), Cook’s D, studentized deleted residual, DFFITS, and DFBETAS.

**Usage**

regD(Formula, Data)

**Arguments**

Formula                a conventional formula for a linear model  
Data                    a data.frame to be analyzed

**Details**

It performs the conventional regression analysis. This does not use g2 inverse, therefore it cannot handle a singular matrix. If the model(design) matrix is not full rank, use REG or fewer parameters.



**Value**

Coefficients	conventional coefficients summary with Wald statistics
Diagnostics	Diagnostics table for detecting outlier or influential/leverage points. This includes fitted (Predicted), residual (Residual), standard error of residual(se_resid), studentized residual(RStudent), hat(Leverage), Cook's D, studentized deleted residual(sdResid), DFFITS, and COVRATIO.
DFBETAS	Column names are the names of coefficients. Each row shows how much each coefficient is affected by deleting the corresponding row of observation.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
regD(uptake ~ conc, C02)
```

---

RR	<i>Relative Risk of the two groups</i>
----	--

---

**Description**

Relative Risk between the two groups

**Usage**

```
RR(y1, n1, y2, n2, conf.level=0.95)
```

**Arguments**

y1	positive event count of test (the first) group
n1	total count of the test (the first) group
y2	positive event count of control (the second) group
n2	total count of control (the second) group
conf.level	confidence level

**Details**

It calculates relative risk of the two groups. No continuity correction here. If you need percent scale, multiply the output by 100.

**Value**

The result is a data.frame.

p1	proportion from the first group
p2	proportion from the second group
RR	relative risk, p1/p2
SElog	standard error of log(RR)
lower	lower confidence limit of RR
upper	upper confidence limit of RR

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[RD](#), [OR](#), [RDmn1](#), [RRmn1](#), [ORMn1](#), [RDmn](#), [RRmn](#), [ORMn](#)

**Examples**

```
RR(104, 11037, 189, 11034) # no continuity correction
```

---

RRinv	<i>Relative Risk of two groups with strata by inverse variance method</i>
-------	---

---

**Description**

Relative risk and its score confidence interval of two groups with stratification by inverse variance method

**Usage**

```
RRinv(d0, conf.level=0.95)
```

**Arguments**

d0	A data.frame or matrix, of which each row means a stratum. This should have four columns named y1, n1, y2, and n2; y1 and y2 for events of each group, n1 and n2 for sample size of each stratum. The second group is usually the control group.
conf.level	confidence level

**Details**

It calculates relative risk and its confidence interval of two groups by inverse variance method. This supports stratification. This can be used for meta-analysis also.

**Value**

The following output will be returned for each stratum and common value. There is no standard error.

p1	proportion from the first group, y1/n1
p2	proportion from the second group, y2/n2
RR	relative risk, p1/p2. The point estimate of common RR is calculated with MH weight.
lower	lower confidence limit of RR
upper	upper confidence limit of RR

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[RDMn1](#), [RRmn1](#), [ORMn1](#), [RDMn](#), [RRmn](#), [ORMn](#), [RDinv](#), [ORinv](#), [ORcmh](#)

**Examples**

```
d1 = matrix(c(25, 339, 28, 335, 23, 370, 40, 364), nrow=2, byrow=TRUE)
colnames(d1) = c("y1", "n1", "y2", "n2")
RRinv(d1)
```

---

RRmn	<i>Relative Risk and Score CI of two groups with strata by the MN method</i>
------	--

---

**Description**

Relative risk and its score confidence interval of two groups with stratification by the Miettinen and Nurminen method

**Usage**

```
RRmn(d0, conf.level=0.95, eps=1e-8)
```

**Arguments**

d0	A data.frame or matrix, of which each row means a strata. This should have four columns named y1, n1, y2, and n2; y1 and y2 for events of each group, n1 and n2 for sample size of each stratum. The second group is usually the control group.
conf.level	confidence level
eps	absolute value less than eps is regarded as negligible

**Details**

It calculates relative risk and its score confidence interval of the two groups. The confidence interval is asymmetric, and there is no standard error in the output. This supports stratification. This implementation uses uniroot function, which usually gives at least 5 significant digits. Whereas PropCIs::riskscoreci function uses cubic equation approximation which gives only about 2 significant digits. This can be used for meta-analysis also.

**Value**

The following output will be returned for each strata and common value. There is no standard error.

p1	proportion from the first group, y1/n1
p2	proportion from the second group, y2/n2
RR	relative risk, p1/p2. Point estimate of common RR is calculated with MN weight.
lower	lower confidence limit of RR
upper	upper confidence limit of RR

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

## References

Miettinen O, Nurminen M. Comparative analysis of two rates. Stat Med 1985;4:213-26

## See Also

[RDmn1](#), [RRmn1](#), [ORmn1](#), [RDmn](#), [ORmn](#), [RDinv](#), [RRinv](#), [ORinv](#), [ORcmh](#)

## Examples

```
d1 = matrix(c(25, 339, 28, 335, 23, 370, 40, 364), nrow=2, byrow=TRUE)
colnames(d1) = c("y1", "n1", "y2", "n2")
RRmn(d1)
```

---

RRmn1	<i>Relative Risk and Score CI of two groups without strata by by MN method</i>
-------	--

---

## Description

Relative risk and its score confidence interval of the two groups without stratification

## Usage

```
RRmn1(y1, n1, y2, n2, conf.level=0.95, eps=1e-8)
```

## Arguments

y1	positive event count of test (the first) group
n1	total count of the test (the first) group
y2	positive event count of control (the second) group
n2	total count of control (the second) group
conf.level	confidence level
eps	absolute value less than eps is regarded as negligible

## Details

It calculates the relative risk and its score confidence interval of the two groups. The confidence interval is asymmetric, and there is no standard error in the output. This does not support stratification. This implementation uses uniroot function, which usually gives at least 5 significant digits. Whereas PropCIs::riskscoreci function uses cubic equation approximation which gives only about 2 significant digits.

## Value

There is no standard error.

p1	proportion from the first group, y1/n1
p2	proportion from the second group, y2/n2
RR	relative risk, p1/p2
lower	lower confidence limit of RR
upper	upper confidence limit of RR

**Author(s)**

Kyun-Seop Bae k@acr.kr

**References**

Miettinen O, Nurminen M. Comparative analysis of two rates. Stat Med 1985;4:213-26

**See Also**

[RDmn1](#), [ORMn1](#), [RDmn](#), [RRmn](#), [ORMn](#)

**Examples**

```
RRmn1(104, 11037, 189, 11034)
```

---

satt

*Satterthwaite Approximation of Variance and Degree of Freedom*

---

**Description**

Calculates pooled variance and degree of freedom using Satterthwaite equation.

**Usage**

```
satt(vars, dfs, ws=c(1, 1))
```

**Arguments**

vars	a vector of variances
dfs	a vector of degree of freedoms
ws	a vector of weights

**Details**

The input can be more than two variances.

**Value**

Variance	approximated variance
Df	degree of freedom

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

ScoreCI*Score Confidence Interval for a Proportion or a Binomial Distribution*

---

**Description**

Score confidence of a proportion in one group

**Usage**

```
ScoreCI(y, n, conf.level=0.95)
```

**Arguments**

y	positive event count of a group
n	total count of a group
conf.level	confidence level

**Details**

It calculates score confidence interval of a proportion in one group. The confidence interval is asymmetric and there is no standard error in the output. If you need percent scale, multiply the output by 100.

**Value**

The result is a data.frame. There is no standard error.

PE	point estimation for the proportion
Lower	lower confidence limit of Prop
Upper	upper confidence limit of Prop

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[binom.test](#), [prop.test](#)

**Examples**

```
ScoreCI(104, 11037)
```

---

SD	<i>Standard Deviation</i>
----	---------------------------

---

**Description**

Standard deviation of a sample.

**Usage**

SD(y)

**Arguments**

y                      a vector of numerics

**Details**

It removes NA in the input vector. The length of the vector should be larger than 1.

**Value**

Sample standard deviation

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

SEM	<i>Standard Error of the Sample Mean</i>
-----	--

---

**Description**

The estimate of the standard error of the sample mean

**Usage**

SEM(y)

**Arguments**

y                      a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

The estimate of the standard error of the sample mean

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

Skewness	<i>Skewness</i>
----------	-----------------

---

**Description**

Skewness with a conventional formula.

**Usage**

`Skewness(y)`

**Arguments**

`y` a vector of numerics

**Details**

It removes NA in the input vector.

**Value**

Estimate of skewness

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[SkewnessSE](#)

---

SkewnessSE	<i>Standard Error of Skewness</i>
------------	-----------------------------------

---

**Description**

Standard error of the skewness with a conventional formula.

**Usage**

`SkewnessSE(y)`

**Arguments**

`y` a vector of numerics

**Details**

It removes NA in the input vector.



Value

Standard error of the estimated skewness

Author(s)

Kyun-Seop Bae k@acr.kr

See Also

[Skewness](#)

---

SLICE	<i>F Test with Slice</i>
-------	--------------------------

---

Description

Do F test with a given slice term.

Usage

SLICE(Formula, Data, Term, By)

Arguments

Formula	a conventional formula for a linear model
Data	a data.frame to be analyzed
Term	a factor name (not interaction) to calculate the sum of square and do F test with least square means
By	a factor name to be used for slice

Details

It performs F test with a given slice term. It is similar to the SLICE option SAS PROC GLM.

Value

Returns sum of square and its F value and p-value. Row names are the levels of the slice term.

Df	degree of freedom
Sum Sq	sum of square for the set of contrasts
Mean Sq	mean square
F value	F value for the F distribution
Pr(>F)	probability of larger than F value

Author(s)

Kyun-Seop Bae k@acr.kr

Examples

```
SLICE(uptake ~ Type*Treatment, C02, "Type", "Treatment")
SLICE(uptake ~ Type*Treatment, C02, "Treatment", "Type")
```

---

SS	<i>Sum of Square</i>
----	----------------------

---

**Description**

Sum of squares with ANOVA.

**Usage**

```
SS(x, rx, L, eps=1e-8)
```

**Arguments**

x	a result of <code>ModelMatrix</code> containing design information
rx	a result of <code>lfit</code>
L	linear hypothesis, a full matrix matching the information in x
eps	Less than this value is considered as zero.

**Details**

It calculates sum of squares and completes the ANOVA table.

**Value**

ANOVA table	a classical ANOVA table without the residual(Error) part.
-------------	---

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[ModelMatrix](#), [lfit](#)

---

T3MS	<i>Type III Expected Mean Square Formula</i>
------	--

---

**Description**

Calculates a formula table for expected mean square of Type III SS.

**Usage**

```
T3MS(Formula, Data, L0, eps=1e-8)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a <code>data.frame</code> to be analyzed
L0	a matrix of row linear contrasts, if missed, e3 is used
eps	Less than this value is considered as zero.

**Details**

This is necessary for further hypothesis tests of nesting factors.

**Value**

A coefficient matrix for Type III expected mean square

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**Examples**

```
T3MS(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata)
```

---

T3test	<i>Test Type III SS using error term other than MSE</i>
--------	---

---

**Description**

Hypothesis test of Type III SS using an error term other than MSE. This corresponds to SAS PROC GLM's RANDOM /TEST clause.

**Usage**

```
T3test(Formula, Data, H="", E="", eps=1e-8)
```

**Arguments**

Formula	a conventional formula for a linear model
Data	a <code>data.frame</code> to be analyzed
H	Hypothesis term
E	Error tem
eps	Less than this value is considered as zero.

**Details**

It tests a factor of type III SS using some other term as an error term. Here the error term should not be MSE.

**Value**

Returns one or more ANOVA table(s) of type III SS.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

```
T3test(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata, E=c("SEQ:SUBJ"))
T3test(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata, H="SEQ", E=c("SEQ:SUBJ"))
```

---

tmttest

---

*Independent two means test similar to t.test with summarized input*


---

**Description**

This produces essentially the same to t.test except using summarized input (sufficient statistics).

**Usage**

```
tmttest(m1, s1, n1, m0, s0, n0, conf.level=0.95, nullHypo=0, var.equal=F)
```

**Arguments**

m1	mean of the first (test, active, experimental) group
s1	sample standard deviation of the first group
n1	sample size of the first group
m0	mean of the second (reference, control, placebo) group
s0	sample standard deviation of the second group
n0	sample size of the second group
conf.level	confidence level
nullHypo	value for the difference of means under null hypothesis
var.equal	assumption on the variance equality

**Details**

The default is Welch t-test with Satterthwaite approximation.

**Value**

The output format is very similar to t.test

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[mtest](#), [TTEST](#), [ztest](#)

**Examples**

```
tmttest(5.4, 10.5, 3529, 5.1, 8.9, 5190) # NEJM 388;15 p1386
tmttest(5.4, 10.5, 3529, 5.1, 8.9, 5190, var.equal=TRUE)
```

---

trimmedMean	<i>Trimmed Mean</i>
-------------	---------------------

---

**Description**

Trimmed mean wrapping mean function.

**Usage**

```
trimmedMean(y, Trim=0.05)
```

**Arguments**

y	a vector of numerics
Trim	trimming proportion. Default is 0.05

**Details**

It removes NA in the input vector.

**Value**

The value of trimmed mean

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

tsum	<i>Table Summary</i>
------	----------------------

---

**Description**

Summarize a continuous dependent variable with or without independent variables.

**Usage**

```
tsum(Formula=NULL, Data=NULL, ColNames=NULL, MaxLevel=30, ...)
```

**Arguments**

Formula	a conventional formula
Data	a data.frame or a matrix
ColNames	If there is no Formula, this will be used.
MaxLevel	More than this will not be handled.
...	arguments to be passed to tsum0, tsum1, tsum2, or tsum3

Details

A convenient summarization function for a continuous variable. This is a wrapper function to tsum0, tsum1, tsum2, or tsum3.

Value

A data.frame of descriptive summarization values.

Author(s)

Kyun-Seop Bae k@acr.kr

See Also

[tsum0](#), [tsum1](#), [tsum2](#), [tsum3](#)

Examples

```
tsum(lh)
t(tsum(CO2))
t(tsum(uptake ~ Treatment, CO2))
tsum(uptake ~ Type + Treatment, CO2)
print(tsum(uptake ~ conc + Type + Treatment, CO2), digits=3)
```

---

tsum0	<i>Table Summary 0 independent(x) variable</i>
-------	--

---

Description

Summarize a continuous dependent(y) variable without any independent(x) variable.

Usage

```
tsum0(d, y, e=c("Mean", "SD", "N"), repl=list(c("length"), c("n")))
```

Arguments

- d                    a data.frame or matrix with colnames
- y                    y variable name, a continuous variable
- e                    a vector of summarize function names
- repl                list of strings to replace after summarize. The length of list should be 2, and both should have the same length.

Details

A convenient summarization function for a continuous variable.

Value

A vector of summarized values

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[tsum](#), [tsum1](#), [tsum2](#), [tsum3](#)

**Examples**

```
tsum0(CO2, "uptake")
tsum0(CO2, "uptake", repl=list(c("mean", "length"), c("Mean", "n")))
```

---

tsum1	<i>Table Summary 1 independent(x) variable</i>
-------	--

---

**Description**

Summarize a continuous dependent(y) variable with one independent(x) variable.

**Usage**

```
tsum1(d, y, u, e=c("Mean", "SD", "N"), ou="", repl=list(c("length"), ("n")))
```

**Arguments**

d	a data.frame or matrix with colnames
y	y variable name. a continuous variable
u	x variable name, upper side variable
e	a vector of summarize function names
ou	order of levels of upper side x variable
repl	list of strings to replace after summarize. The length of list should be 2, and both should have the same length.

**Details**

A convenient summarization function for a continuous variable with one x variable.

**Value**

A data.frame of summarized values. Row names are from e names. Column names are from the levels of x variable.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[tsum](#), [tsum0](#), [tsum2](#), [tsum3](#)

## Examples

```
tsum1(CO2, "uptake", "Treatment")
tsum1(CO2, "uptake", "Treatment",
      e=c("mean", "median", "sd", "min", "max", "length"),
      ou=c("chilled", "nonchilled"),
      repl=list(c("median", "length"), c("med", "n")))
```

---

tsum2	<i>Table Summary 2 independent(x) variables</i>
-------	---

---

## Description

Summarize a continuous dependent(y) variable with two independent(x) variables.

## Usage

```
tsum2(d, y, l, u, e=c("Mean", "SD", "N"), h=NULL, ol="", ou="", rm.dup=TRUE,
      repl=list(c("length"), c("n")))
```

## Arguments

d	a data.frame or matrix with colnames
y	y variable name. a continuous variable
l	x variable name to be shown on the left side
u	x variable name to be shown on the upper side
e	a vector of summarize function names
h	a vector of summarize function names for the horizontal subgroup. If NULL, it becomes the same as e argument.
ol	order of levels of left side x variable
ou	order of levels of upper side x variable
rm.dup	if TRUE, duplicated names of levels are specified on the first occurrence only.
repl	list of strings to replace after summarize. The length of list should be 2, and both should have the same length.

## Details

A convenient summarization function for a continuous variable with two x variables; one on the left side, the other on the upper side.

## Value

A data.frame of summarized values. Column names are from the levels of u. Row names are basically from the levels of l.

## Author(s)

Kyun-Seop Bae k@acr.kr



**See Also**

[tsum](#), [tsum0](#), [tsum1](#), [tsum3](#)

**Examples**

```
tsum2(CO2, "uptake", "Type", "Treatment")
tsum2(CO2, "uptake", "Type", "conc")
tsum2(CO2, "uptake", "Type", "Treatment",
      e=c("mean", "median", "sd", "min", "max", "length"),
      ou=c("chilled", "nonchilled"),
      repl=list(c("median", "length"), c("med", "n")))
```

---

tsum3

*Table Summary 3 independent(x) variables*

---

**Description**

Summarize a continuous dependent(y) variable with three independent(x) variables.

**Usage**

```
tsum3(d, y, l, u, e=c("Mean", "SD", "N"), h=NULL, ol1="", ol2="", ou="",
      rm.dup=TRUE, repl=list(c("length"), c("n")))
```

**Arguments**

d	a data.frame or matrix with colnames
y	y variable name. a continuous variable
l	a vector of two x variable names to be shown on the left side. The length should be 2.
u	x variable name to be shown on the upper side
e	a vector of summarize function names
h	a list of two vectors of summarize function names for the first and second horizontal subgroups. If NULL, it becomes the same as e argument.
ol1	order of levels of 1st left side x variable
ol2	order of levels of 2nd left side x variable
ou	order of levels of upper side x variable
rm.dup	if TRUE, duplicated names of levels are specified on the first occurrence only.
repl	list of strings to replace after summarize. The length of list should be 2, and both should have the same length.

**Details**

A convenient summarization function for a continuous variable with three x variables; two on the left side, the other on the upper side.

**Value**

A data.frame of summarized values. Column names are from the levels of u. Row names are basically from the levels of l.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[tsum](#), [tsum0](#), [tsum1](#), [tsum2](#)

**Examples**

```
tsum3(CO2, "uptake", c("Type", "Treatment"), "conc")
tsum3(CO2, "uptake", c("Type", "Treatment"), "conc",
      e=c("mean", "median", "sd", "min", "max", "length"),
      h=list(c("mean", "sd", "length"), c("mean", "length")),
      ol2=c("chilled", "nonchilled"),
      repl=list(c("median", "length"), c("med", "n")))
```

---

TTEST

---

*Independent two groups t-test comparable to PROC TTEST*


---

**Description**

This is comparable to SAS PROC TTEST.

**Usage**

```
TTEST(x, y, conf.level=0.95)
```

**Arguments**

x	a vector of data from the first (test, active, experimental) group
y	a vector of data from the second (reference, control, placebo) group
conf.level	confidence level

**Details**

Caution on choosing the row to use in the output.

**Value**

The output format is comparable to SAS PROC TTEST.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**See Also**

[mtest](#), [tmtest](#), [ztest](#)

**Examples**

```
TTEST(mtcars[mtcars$am==1, "mpg"], mtcars[mtcars$am==0, "mpg"])
```

---

UCL	<i>Upper Confidence Limit</i>
-----	-------------------------------

---

**Description**

The estimate of the upper bound of the confidence limit using t-distribution

**Usage**

```
UCL(y, conf.level=0.95)
```

**Arguments**

y	a vector of numerics
conf.level	confidence level

**Details**

It removes NA in the input vector.

**Value**

The estimate of the upper bound of the confidence limit using t-distribution

**Author(s)**

Kyun-Seop Bae k@acr.kr

---

UNIV	<i>Univariate Descriptive Statistics</i>
------	--

---

**Description**

Returns descriptive statistics of a numeric vector.

**Usage**

```
UNIV(y, conf.level = 0.95)
```

**Arguments**

y	a numeric vector
conf.level	confidence level for confidence limit

**Details**

A convenient and comprehensive function for descriptive statistics. NA is removed during the calculation. This is similar to SAS PROC UNIVARIATE.

**Value**

nAll	count of all elements in the input vector
nNA	count of NA element
nFinite	count of finite numbers
Mean	mean excluding NA
SD	standard deviation excluding NA
CV	coefficient of variation in percent
SEM	standard error of the sample mean, the sample mean divided by nFinite
LowerCL	lower confidence limit of mean
UpperCL	upper confidence limit of mean
TrimmedMean	trimmed mean with trimming 1 - confidence level
Min	minimum value
Q1	first quartile value
Median	median value
Q3	third quartile value
Max	maximum value
Range	range of finite numbers. maximum - minimum
IQR	inter-quartile range type 2, which is SAS default
MAD	median absolute deviation
VarLL	lower confidence limit of variance
VarUL	upper confidence limit of variance
Skewness	skewness
SkewnessSE	standard error of skewness
Kurtosis	kurtosis
KurtosisSE	kurtosis
GeometricMean	geometric mean, calculated only when all given values are positive.
GeometricCV	geometric coefficient of variation in percent, calculated only when all given values are positive.

**Author(s)**

Kyun-Seop Bae k@acr.kr

**Examples**

UNIV(1h)

---

vtest	<i>F-Test for the ratio of two groups' variances</i>
-------	--

---

### Description

F-test for the ratio of two groups' variances. This is similar to `var.test` except using the summarized input.

### Usage

```
vtest(v1, n1, v0, n0, ratio=1, conf.level=0.95)
```

### Arguments

<code>v1</code>	sample variance of the first (test, active, experimental) group
<code>n1</code>	sample size of the first group
<code>v0</code>	sample variance of the second (reference, control, placebo) group
<code>n0</code>	sample size of the second group
<code>ratio</code>	value for the ratio of variances under null hypothesis
<code>conf.level</code>	confidence level

### Details

For the confidence interval of one group, use `UNIV` function.

### Value

The output format is very similar to `var.test`.

### Author(s)

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

### Examples

```
vtest(10.5^2, 5190, 8.9^2, 3529) # NEJM 388;15 p1386
vtest(2.3^2, 13, 1.5^2, 11, conf.level=0.9) # Red book p240
```

---

WhiteTest

*White's Model Specification Test*


---

### Description

This is shown in SAS PROC REG as the Test of First and Second Moment Specification.

### Usage

```
WhiteTest(rx)
```

### Arguments

rx                      a result of lm

### Details

This is also called as White's general test for heteroskedasticity.

### Value

Returns a direct test result by more complex theorem 2, not by simpler corollary 1.

### Author(s)

Kyun-Seop Bae k@acr.kr

### References

White H. A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica* 1980;48(4):817-838.

### Examples

```
WhiteTest(lm(mpg ~ disp, mtcars))
```

---

ztest

*Test for the difference of two groups' means*


---

### Description

This is similar to two groups t-test, but using standard normal (Z) distribution.

### Usage

```
ztest(m1, s1, n1, m0, s0, n0, conf.level=0.95, nullHypo=0)
```

**Arguments**

m1	mean of the first (test, active, experimental) group
s1	known standard deviation of the first group
n1	sample size of the first group
m0	mean of the second (reference, control, placebo) group
s0	known standard deviation of the second group
n0	sample size of the second group
conf.level	confidence level
nullHypo	value for the difference of means under null hypothesis

**Details**

Use this only for known standard deviations (or variances) or very large sample sizes per group.

**Value**

The output format is very similar to `t.test`

**Author(s)**

Kyun-Seop Bae [k@acr.kr](mailto:k@acr.kr)

**See Also**

[mtest](#), [tmtest](#), [TTEST](#)

**Examples**

```
ztest(5.4, 10.5, 3529, 5.1, 8.9, 5190) # NEJM 388;15 p1386
```

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