Package ‘daewr’

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Type Package

Title Design and Analysis of Experiments with R

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Author John Lawson

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Description This package contains data frames and functions used in the book ‘‘Design and Analysis of Experiments with R’’

License GPL-2

Dependencies FrF2,BsMD

LazyLoad yes

R topics documented:

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daewr-package *Data frames and functions for Design and Analysis of Experiments with R*

Description

This package contains the data sets and functions from the book Design and Analysis of Experiments with R published by CRC in 2013.

Details

Package:	daewr
Type:	Package
Version:	1.0
Date:	2012-05-10
License:	GPL-2
LazyLoad:	yes

Author(s)

John Lawson

Maintainer: John Lawson <lawson@byu.edu>

References

J. Lawson, Design and Analysis of Experiments with R, CRC 2013.

Examples

```
Fcrit(.05,2,15)
Fpower(0.05,2,15,6.428)
BIBsize(6,3)
```

---

antifungal *Two-period crossover study of antifungal agent*

Description

Data from the Two-period crossover study of an antifungal agent in chapter 9 of Design and Analysis of Experiments with R

Usage

```
data(antifungal)
```

Format

A data frame with 34 observations on the following 5 variables.

`Group` a factor with levels `1` `2`

`Subject` a factor with levels `1` `2` `3` `4` `5` `6` `7` `8` `9` `10` `11` `12` `14` `15` `16` `17` `18`

`Period` a factor with levels `1` `2`

`Treat` a factor with levels `A` `B`

`pl` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(antifungal)
```

`Apo` *apolipoprotein survey varaince component study*

Description

Data from the apolipoprotein survey variance component study of Chapter 5 in Design and Analysis of Experiments with R

Usage

```
data(Apo)
```

Format

A data frame with 30 observations on the following 2 variables.

`lab` a factor with levels `A` `B` `C` `D`

`conc` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(Apo)
```

`apple` *Confounded apple slice browning experiment*

Description

Data from the confounded apple slice browning experiment in chapter 7 of Design and Analysis of Experiments with R

Usage

```
data(apple)
```

Format

A data frame with 24 observations on the following 4 variables.

`Block` a factor with levels `1` `2` `3` `4`

`A` a factor with levels `0` `1` `2` `3`

`B` a factor with levels `0` `1` `2`

`rating` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(apple)
```

`arso` $2\hat{}(7-3)$ *arsenic removal experiment*

Description

Data from the $2^{(7-3)}$ arsenic removal experiment in chapter 6 of Design and Analysis of Experiments with R

Usage

```
data(arso)
```

Format

A data frame with 8 observations on the following 8 variables.

`A` a factor with levels `-1` `1`

`B` a factor with levels `-1` `1`

`C` a factor with levels `-1` `1`

`D` a factor with levels `-1` `1`

`E` a factor with levels `-1` `1`

`F` a factor with levels `-1` `1`

`G` a factor with levels `-1` `1`

`y1` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(arso)
```

`augm` $2\hat{}(7-3)$ *arsenic removal experiment augmented with mirror image*

Description

Data from the $2^{(7-3)}$ arsenic removal experiment augmented with mirror image in chapter 6 of Design and Analysis of Experiments with R

Usage

```
data(augm)
```

Format

A data frame with 8 observations on the following 8 variables.

`A` a factor with levels `-1` `1`

`B` a factor with levels `-1` `1`

`C` a factor with levels `-1` `1`

`fold` a factor with levels `original` `mirror`

`D` a factor with levels `-1` `1`

`E` a factor with levels `-1` `1`

`F` a factor with levels `-1` `1`

`G` a factor with levels `-1` `1`

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(augm)
```

Bdish *Confounded Block Dishwashing Experiment*

Description

Data from the Confounded Block Dishwashing Experiment in chapter 7 of Design and Analysis of Experiments with R

Usage

```
data(Bdish)
```

Format

A data frame with 16 observations on the following 5 variables.

`Blocks` a factor with levels `1` `2` `3` `4`

`A` a factor with levels `-1` `1`

`B` a factor with levels `-1` `1`

`C` a factor with levels `-1` `1`

`D` a factor with levels `-1` `1`

`y` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(Bdish)
```

Bff *Confounded block fractional mouse growth experiment*

Description

Data from the Confounded block fractional factorial mouse growth experiment in chapter 7 of Design and Analysis of Experiments with R

Usage

```
data(Bff)
```

Format

A data frame with 16 observations on the following 5 variables.

`Blocks` a factor with levels `1 2 3 4 5 6 7 8`

`A` a factor with levels `-1 1`

`B` a factor with levels `-1 1`

`C` a factor with levels `-1 1`

`D` a factor with levels `-1 1`

`E` a factor with levels `-1 1`

`F` a factor with levels `-1 1`

`G` a factor with levels `-1 1`

`H` a factor with levels `-1 1`

`weight` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(Bff)
```

bha *mouse liver enzyme experiment*

Description

Data from the mouse liver enzyme experiment in chapter 4 of Design and Analysis of Experiments with R

Usage

```
data(bha)
```

Format

A data frame with 16 observations on the following 4 variables.

`block` a factor with levels `1` `2`

`strain` a factor with levels `A/J` `129Ola` `NIH` `BALB/c`

`treat` a factor with levels `treated` `control`

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(bha)
```

BIBsize *Balanced incomplete blocksize*

Description

This function computes the number of blocks, treatment frequency and lambda for a potential BIB design

Usage

```
BIBsize(t,k)
```

Arguments

`t`	input - number of levels of the treatment factor
`k`	input - blocksize or number of experimental units per block

Value

a list containing the b=number of blocks, r=number of treatment replicates and lambda for a potential BIB design with t levels of treatment factor and blocksize k.

Author(s)

John Lawson

Examples

```
BIBsize(6,3)

## The function is currently defined as
BIBsize<-function(t,k)
{
  b<-t
  r<-0
  lambda<-0
  check<-0
  while (check==0) {
   while (r==0) {
     #cat("r=",r)
     testr<-(b*k)/t
     #cat("testr=",testr,"b=",b)
     if (testr==floor(testr)) {
       r<-testr
       } else {
       b<-b+1
       }
     }
      #cat("b=",b, "r=",r)
      testl<-(r*(k-1))/(t-1)
      #cat("testl=",testl,"b=",b)
      if (testl==floor(testl)) {
       lambda<-testl
       check=1
       } else {
       r<-0
       b<-b+1
      #cat("b=",b, "r=",r)
        }
}
```

---

bioequiv *Extra-period crossover bioequivalence study*

Description

Data from the extra-period crossover bioequivalence study in chapter 9 of Design and Analysis of Experiments with R

Usage

```
data(bioequiv)
```

Format

A data frame with 108 observations on the following 5 variables.

`Group` a factor with levels `1 2`

`Subject` a factor with levels `1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 21 23 24 25 26 27 28 30 31 32 33` code`34 35 36 120 122 129`

`Period` a factor with levels `1 2 3`

`Treat` a factor with levels `A B`

`Carry` a factor with levels `none A B`

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(bioequiv)
```

`bioeqv` *Latin Square bioequivalence experiment*

Description

Data from the Latin Square bioequivalence experiment in chapter 4 of Design and Analysis of Experiments with R

Usage

```
data(bioeqv)
```

Format

A data frame with 9 observations on the following 4 variables.

`Period` a factor with levels `1 2` code3

`Subject` a factor with levels `1 2` code3

`Treat` a factor with levels `A B C`

`AUC` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(bioeqv)
```

`blood` *Variance component study of calcium in blood serum*

Description

Data from the Variance component study of calcium in blood serum in chapter 5 of Design and Analysis of Experiments with R

Usage

```
data(blood)
```

Format

A data frame with 27 observations on the following 3 variables.

`sol` a factor with levels `1` `2` `3` `4`

`lab` a factor with levels `A` `B` `C`

`calcium` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(blood)
```

`BoxM` *Box and Meyer's unreplicated* $2\hat{}4$ *from Chapter 3*

Description

Data from Box and Meyer's unreplicated 2^4 in chapter 3 of Design and Analysis of Experiments with R

Usage

```
data(BoxM)
```

Format

A data frame with 16 observations on the following 4 variables.

`A` a numeric vector containing the coded (-1,1) levels of factor A

`B` a numeric vector containing the coded (-1,1) levels of factor B

`C` a numeric vector containing the coded (-1,1) levels of factor C

`D` a numeric vector containing the coded (-1,1) levels of factor D

`y` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

References

Box, G. E. P. "George's Column", *Quality Engineering*, Vol. 3, pp. 405-410.

Examples

```
data(BoxM)
```

`BPmonitor` *blood pressure monitor experiment*

Description

Data from the blood pressure monitor experiment experiment in Chapter 7 of Design and Analysis of Experiments with R

Usage

```
data(BPmonitor)
```

Format

A data frame with 12 observations on the following 3 variables.

`Block` a factor with levels `1 2 3 4 5 6`

`Treatment` a factor with levels `"P" "A" "B" "C"`

`pressure` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(BPmonitor)
```

bread *Bread rise experiment data from Chapter 2*

Description

Data from the bread rise experiment in chapter 2 of Design and Analysis of Experiments with R

Usage

```
data(bread)
```

Format

A data frame with 12 observations on the following 3 variables.

`loaf` a numeric vector

`time` a numeric vector

`height` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(bread)
```

cake *Split-Plot response surface for cake baking experiment*

Description

Data from the Split-Plot response surface for cake baking experiment in chapter 10 of Design and Analysis of Experiments with R

Usage

```
data(cake)
```

Format

A data frame with 11 observations on the following 4 variables.

`Ovenrun` a factor with levels `1` `2` `3` `4`

`x1` a numeric vector

`x2` a numeric vector

`y` a numeric vector

`x1sq` a numeric vector

`x2sq` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(cake)
```

---

castf *cast fatigue experiment*

Description

Data from the cast fatigue experiment in chapter 6 of Design and Analysis of Experiments with R

Usage

```
data(castf)
```

Format

A data frame with 12 observations on the following 12 variables.

`c8` a factor with levels `-1` `1`

`c9` a factor with levels `-1` `1`

`c10` a factor with levels `-1` `1`

`c11` a factor with levels `-1` `1`

`G` a factor with levels `-1` `1`

`F` a factor with levels `-1` `1`

`E` a factor with levels `-1` `1`

`D` a factor with levels `-1` `1`

`C` a factor with levels `-1` `1`

`B` a factor with levels `-1` `1`

`A` a factor with levels `-1` `1`

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(castf)
```

`cement` *CCD design for cement workability experiment*

Description

Data from the CCD design for cement workability experiment in chapter 10 of Design and Analysis of Experiments with R

Usage

```
data(cement)
```

Format

A data frame with 20 observations on the following 4 variables.

`Block` a factor with levels `1` `2`

`x1` a numeric vector

`x2` a numeric vector

`x3` a numeric vector

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(cement)
```

`chem` *Chemical process experiment data from Chapter 3*

Description

Data from the Chemical process experiment in chapter 3 of Design and Analysis of Experiments with R

Usage

```
data(chem)
```

Format

A data frame with 16 observations on the following 4 variables.

`A` a numeric vector containing the coded (-1,1) levels of factor A

`B` a numeric vector containing the coded (-1,1) levels of factor B

`C` a numeric vector containing the coded (-1,1) levels of factor C

`D` a numeric vector containing the coded (-1,1) levels of factor D

`y` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(chem)
```

---

chipman *Williams' crossover design for sprinting experiment*

Description

Data from the Williams' crossover design for sprinting experiment in chapter 9 of Design and Analysis of Experiments with R

Usage

```
data(chipman)
```

Format

A data frame with 36 observations on the following 5 variables.

`Square` a factor with levels `1` `2`

`Group` a factor with levels `1` `2` `3`

`Subject` a factor with levels `1` `2` code3 `4` `5` code6 `7` `8` code9 `10` `11` code12

`Period` a factor with levels `1` `2` `3`

`Treat` a factor with levels `1` `2` `3`

`Carry` a factor with levels `0` `1` `2` `3`

`Time` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(chipman)
```

`COdata` *CO emmisions experiment data from Chapter 3*

Description

Data from the CO emissions experiment in chapter 3 of Design and Analysis of Experiments with R

Usage

```
data(COdata)
```

Format

A data frame with 18 observations on the following 3 variables.

`Eth` a factor with levels `0.1` `0.2` `0.3`

`Ratio` a factor with levels `14` `15` `16`

`CO` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(COdata)
```

`cont` *Control factor array and summary statistics for controller circuit design experiment*

Description

Data from the control factor array and summary statistics for controller circuit design experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(cont)
```

Format

A data frame with 18 observations on the following 6 variables.

`A` a numeric vector

`B` a numeric vector

`C` a numeric vector

`D` a numeric vector

`F` a numeric vector

`lns2` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(cont)
```

`cpipe` *Split-plot response surface for ceramic pipe experiment*

Description

Data from the Split-plot response surface for ceramic pipe experiment in chapter 10 of Design and Analysis of Experiments with R

Usage

```
data(cpipe)
```

Format

A data frame with 48 observations on the following 6 variables.

`WP` a factor with levels `1` `2` `3` `4` `5` `6` `7` `8` `9` `10` `11` `12`

`A` a numeric vector

`B` a numeric vector

`P` a numeric vector

`Q` a numeric vector

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(cpipe)
```

`culture` *paecilomyces variotii culture experiment*

Description

Data from the paecilomyces variotii culture experiment experiment in chapter 6 of Design and Analysis of Experiments with R

Usage

```
data(culture)
```

Format

A data frame with 16 observations on the following 9 variables.

- `A` a factor with levels `-1` `1`
- `B` a factor with levels `-1` `1`
- `C` a factor with levels `-1` `1`
- `D` a factor with levels `-1` `1`
- `E` a factor with levels `-1` `1`
- `F` a factor with levels `-1` `1`
- `G` a factor with levels `-1` `1`
- `H` a factor with levels `-1` `1`
- `y1` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(culture)
```

`dairy` *Repeated measures study with dairy cow diets*

Description

Data from the Repeated measures study with dairy cow diets in chapter 9 of Design and Analysis of Experiments with R (compact format)

Usage

```
data(dairy)
```

Format

A data frame with 120 observations on the following 5 variables.

`Diet` a factor with levels `"Barley"` `"Mixed"` `"Lupins"`

`pr1` a numeric vector

`pr2` a numeric vector

`pr3` a numeric vector

`pr4` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(dairy)
```

`drug` *Data from rat behavior experiment in Chapter 4*

Description

Data from rat behavior experiment in Chapter 4 of Design and Analysis of Experiments with R

Usage

```
data(drug)
```

Format

A data frame with 50 observations on the following 3 variables.

`rat` a factor with levels `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`

`dose` a factor with levels `0.0` `0.5` `1.0` `1.5` `2.0`

`rate` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(drug)
```

`eptaxr` *Single array and raw response for silicon layer growth experiment*

Description

Data from the single array and raw response for silicon layer growth experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(eptaxr)
```

Format

A data frame with 64 observations on the following 9 variables.

- `A` a numeric vector
- `B` a numeric vector
- `C` a numeric vector
- `D` a numeric vector
- `E` a numeric vector
- `F` a numeric vector
- `G` a numeric vector
- `H` a numeric vector
- `y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(eptaxr)
```

`eptaxs2` *Control array and variance of response for silicon layer growth experiment*

Description

Data from the control array and variance of response for silicon layer growth experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(eptaxs2)
```

Format

A data frame with 16 observations on the following 9 variables.

- `A` a numeric vector
- `B` a numeric vector
- `C` a numeric vector
- `D` a numeric vector
- `E` a numeric vector
- `F` a numeric vector
- `G` a numeric vector
- `H` a numeric vector
- `s2` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(eptaxs2)
```

`eptaxyb` *Control array and mean response for silicon layer growth experiment*

Description

Data from the control array and mean response for silicon layer growth experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(eptaxyb)
```

Format

A data frame with 16 observations on the following 9 variables.

- `A` a numeric vector
- `B` a numeric vector
- `C` a numeric vector
- `D` a numeric vector
- `E` a numeric vector
- `F` a numeric vector
- `G` a numeric vector
- `H` a numeric vector
- `ybar` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(eptaxyb)
```

Fcrit *F-Distribution critical values*

Description

Gets F-distribution critical values

Usage

```
Fcrit(alpha, nu1, nu2)
```

Arguments

alpha	input- right tail area beyond critical value
nu1	input - numerator degrees of freedom for F-distribution
nu2	input - denominator degrees of freedom for F-distribution

Value

returned critical value

Author(s)

John Lawson

Examples

```
Fcrit(.05,2,15)
## The function is currently defined as
function(alpha,nu1,nu2) qf(1-alpha,nu1,nu2)
```

Fpower *F-Distribution Power Calculation*

Description

Calculates the power for the non-central F-distribution

Usage

```
Fpower(alpha, nu1, nu2, nc)
```

Arguments

alpha	input - critical value alpha
nu1	input - degrees of freedom for numerator
nu2	input - degrees of freedom for denominator
nc	input - noncentrality parameter

Value

probability of exceeding fcrit(alpha, nu1,nu2) with the non-central F-distribution with nu1 and nu2 degrees of freedom and noncentrality parameter nc

Author(s)

John Lawson

Examples

```
Fpower(0.05,2,15,6.428)

## The function is currently defined as
function(alpha,nu1,nu2,nc) 1-pf(Fcrit(alpha,nu1,nu2),nu1,nu2,nc)
```

fullnormal *Nornal Plot of Effects*

Description

This function makes a full normal plot of effects labeling those significant and by default adds the reference line (refline).

Usage

```
fullnormal<-function(effects,labs,alpha=.05,refline="TRUE")
```

Arguments

`effects`	input - This is the numeric vector of effects or regression coefficients to be plotted; it should not include the intercept.
`labs`	input - This is the character vector of effect labels usually obtained from the lm function.
`alpha`	input - The significance level of the test. The default is .05 if alpha is not specified.
`refline`	input - logical, the default value is TRUE which indicates a reference line will be added to the plot.

Author(s)

John Lawson

Examples

```
data(plasma)
sol<-lm(y~A*B*C*D*E,data=plasma)
# get whole plot effects and split plot effects
effects<-coef(sol)
effects<-effects[c(2:32)]
Wpeffects<-effects[c(1:4, 6:11, 16:19, 26)]
Speffects<-effects[c(5,12:15,20:25,27:31)]
#make separate normal plots
fullnormal(Wpeffects,names(Wpeffects),alpha=.10)
fullnormal(Speffects,names(Speffects),alpha=.05)
# make normal plot of all effects
fullnormal(effects,names(effects),alpha=.01,refline=FALSE)



## The function is currently defined as
fullnormal<-function(effects,labs,alpha=.05,refline="TRUE") {
crit<-LenthPlot(effects,alpha=alpha,plt=FALSE)["ME"]
names<-names(effects)
names<-gsub(':','',names)
names<-gsub('1','',names)
le<-length(effects)
 for (i in 1:le) {
     logc<-(abs(effects[i])<=crit)
     if (logc) {names[i]<-" "}
                 }
qqnorm(effects, ylab="Estimated Effects", xlab="Normal Scores")
x<-qqnorm(effects,plot=FALSE)
zscr<-(x$x)
# Splits effects into positive and negative for labeling
effp<-effects[zscr>0]
zp<-zscr[zscr>0]
namep<-names[zscr>0]
effn<-effects[zscr<0]
zn<-zscr[zscr<0]
namen<-names[zscr<0]
text(zp,effp,namep,pos=1)
text(zn,effn,namen,pos=3)
# calculate pse statistic
```

```
ahe<-abs(effects)
s0<-1.5*median(ahe)
selhe<-ahe<(2.5*s0)
pse=1.5*median(ahe[selhe])
if (refline) {
# add reference line to plot
abline(0,pse)
  }

}
```

---

gagerr *Gauge R&R Study*

Description

Data from the Gauge R&R Study in chapter 5 of Design and Analysis of Experiments with R

Usage

```
data(gagerr)
```

Format

A data frame with 60 observations on the following 3 variables.

`part` a factor with levels `1 2 3 4 5 6 7 8 9 10`

`oper` a factor with levels `1 2 3`

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(gagerr)
```

`gapstat` *Gap Statistic*

Description

This function calculates the gap statistic used in the automated Daniel method of detecting an outlier in an 8, 16 or 32 run 2^{k-p} design.

Usage

```
gapstat<-function(beta,pse)
```

Arguments

`beta` input - This is the the vector of effects or regression coefficients calculated from the design where an outlier is suspected. This vector of coefficients should not include the intercept. This function is called by the function Gaptest at the first and second pass through the data.

`pse` input - This Lenth's pse statistic calculated on the vector beta befor the call to this function.

Value

The result is the gap statistic $gap = ((\beta_s - \beta_l)/pse)/(z_s - z_l)$.

Author(s)

John Lawson

References

Lawson, J. and Gatlin, J. "Finding bad values in factorials - revisited" *Quality Engineering* Vol 18, pages 491-501., 2006.

Examples

```
Beta<-c(.06,.25,-.01,.5,0,-.02,0,.14,.03,-.01,.02,.04,.02,.01,.02)
names(Beta)<-c("A","B","C","D","AB","AC","AD","BC","BD","CD","ABC","ABD","ACD","BCD","ABCD")
gapstat(Beta,.06)

## The function is currently defined as
gapstat<-function(beta,pse) {
# computes the standardized gap score
p<-length(beta)
psehe<-pse
# gets positive coefficients
sel<-beta >= 0
betap<-beta[sel]
# sorts positive elements
betap<-sort(betap)
# gets Beta_s
betas<-betap[1]
#gets negative coefficients
```

```
sel<-beta < 0
betan<-beta[sel]
nn<-length(betan)
# sorts negative coefficients
betan<-sort(betan)
#gets Beta_L
betal<-betan[nn]
# gets Z_L and Z_S
zl<-qnorm((nn-.375)/(p+.25))
zs<-qnorm((nn+1-.375)/(p+.25))
# calculates gap statistic
gap<-((betas-betal)/psehe)/(zs-zl)
return(gap)
                      }
```

Gaptest *Automated Daniel Method*

Description

This function performs and automated version of Daniels method for detecting an outlier in a $2^{(k-p)}$ design by recognizing a gap in the full normal plot of effects. This function calls the functions gapstat and LGB.

Usage

```
Gaptest<-function(DesY)
```

Arguments

DesY input - This is a data frame containing a $2^{(k-p)}$ design augmented with a single column y of responses. This function only works for 8, 16 or 32 run designs.

Author(s)

John Lawson

References

Lawson, J. and Gatlin, J. "Finding bad values in factorials - revisited" *Quality Engineering* Vol 18, pages 491-501., 2006.

Examples

```
# Lawson Gatlin Example
library(FrF2)
lawg<-FrF2(16,11,generators=c("ABC","BCD","ACD","ABD","ABCD","AB","AC"),randomize=FALSE)
y<-c(31,48,43,32,54,52,60,34,47,43,30,26,67,49,80,41)
lawg<-cbind(lawg,y)
Gaptest(lawg)

# eight run example
```

```
library(FrF2)
des<-FrF2(8,6,generators=c("AB","AC","BC"),randomize=FALSE)
y<-c(1.299,1.601,1.359,1.461,1.338,1.486,1.330,1.470)
Des8<-cbind(des,y)
Gaptest(Des8)
#tes<-lm(y~(.)^3,data=Des8)
#summary(tes)
#c<-tes$coef
#cn<-names(c)
#ccn<-gsub("[^A-Z]","",cn)




## The function is currently defined as
Gaptest<-function(DesY) {
# function to compute gap statistic
ncheck<-dim(DesY)
ncheck<-ncheck[1]
 tcnd=TRUE
 if (ncheck==8) {tcnd=FALSE}
 if (ncheck==16) {tcnd=FALSE}
 if (ncheck==32) {tcnd=FALSE}
 if (tcnd) {stop("This function only works for 8, 16, or 32 run designs","\n")
    } else {
if (ncheck==8) ncheck=16
#####################################
# 50th and 99th percentiles of the gap statistic ##
critg16<-c(1.7884,5.1009)
critg32<-c(1.7297,5.8758)

### First Pass through the data ####

###### Step 1  #######
#fit model to saturated design
modf<-lm(y~(.)^4,x=TRUE,data=DesY)


#extract the regression coefficients
nbeta<-dim(DesY)
nbeta<-nbeta[1]
he<-modf$coef
# This extracts the coefficients that are not NA
selcol<-which(!is.na(he))
he<-he[selcol]
he<-he[-1]
#number of coefficients
p<-length(he)
#number of runs
n<-p+1
# This trims unnecessary characters from coefficient names
cn1<-names(he)
ccn1<-gsub("[^A-Z]","",cn1)
names(he)<-ccn1

##### End of Step 1 ########
```

```
###### Steps 2 and 3  #######
#calculate the pse statistic
ahe<-abs(he)
s0<-1.5*median(ahe)
selhe<-ahe<(2.5*s0)
pse=1.5*median(ahe[selhe])
#library(BsMD)
#pse<-LenthPlot(modf,plt=FALSE)
#pse<-pse[2]
#calculate the gap statistic
gap<-gapstat(he,pse)
# checks to see if gap statistic exceeds 50th percentile
if (ncheck==16) {test=(gap>critg16[1])
 } else  {test=(gap>critg32[1])}
##### End Step 2 and 3  #####

if (test) {
##### Step 4  #####
#extract the model X matrix
X<-modf$x
# This selects columns of the X matrix that correspond to non-missing
# coefficients
X<-X[,selcol]
X<-X[,-1]
#gets signs of regression coefficients
se<-as.matrix(sign(he),nrow=1)
# find signigicant effects using LGB
sigef<-LGB(he,rpt=FALSE,plt=FALSE)
# make signs of significant effects zero
 for (i in 1:length(he)) {
     if (sigef[i]=="yes")   {se[i]=0 }
                         }
#gets sum of products of signed effects and rows of X matrix
sp<-X

#finds index of largest sum of products as index of potential outlier
asp<-abs(sp)
oo<-max.col(t(asp))

### End Step 4 ####

###### Step 5  ######

# calculates the bias
 # first get absolute regression coefficients
ae<-abs(he)
 # next sort absolute effects
sae<-sort(ae)
 #get the number of effects in smallest half
nsmall<-round(length(he)/2)
 # sum the smallest half absolute effects to get bias
bias<-2*sum(sae[1:nsmall])

##### Step 6 ######
 # gets corrected response vector
y<-DesY$y
ycorr<-DesY$y
```

```
ycorr[oo]<-ycorr[oo]+(-1*sign(sp[oo]))*bias
 # makes vector of indicators for outlier
detect<-c(rep("no",n))
detect[oo]<-"yes"
cat("Initial Outlier Report","\n")
cat("Standardized-Gap = ",gap, "Significant at 50th percentile","\n")
### End of first pass throught the data #######

### Second Pass throught the data ###########
### Step 1 ####
# augment DesY with corrected data
DesYc<-cbind(DesY[,1:(dim(DesY)[2]-1)],ycorr)
# fit saturated model to corrected data
modf<-lm(ycorr~(.)^4,x=TRUE,data=DesYc)

#extract the regression coefficients
che<-modf$coef
# This extracts the coefficients that are not NA
che<-che[!is.na(che)]
che<-che[-1]
#number of coefficients
p<-length(che)
#number of runs
n<-p+1
# This trims unnecessary characters from coefficient names
cn<-names(che)
ccn<-gsub("[^A-Z]","",cn)
names(che)<-ccn
### End of Step 1 ####

###### Steps 2 and 3  #######
#calculate the pse statistic
ache<-abs(che)
s0<-1.5*median(ache)
selche<-ache<(2.5*s0)
psec=1.5*median(ache[selche])

#psec<-LenthPlot(modf,plt=FALSE)
#psec<-psec[2]
#calculate the gap statistic
gap<-gapstat(he,psec)
# checks to see if gap statistic exceeds 99th percentile
if (ncheck==16) test2=(gap>critg16[2]) else  test2=(gap>critg32[2])
##### End Step 2 and 3  #####

if (test2) {
cat("Final Outlier Report","\n")
cat("Standardized-Gap = ",gap, "Significant at 99th percentile","\n")
cat("   ","\n")
cat("    Corrrected Data Report  ","\n")
cat("Response  Corrected Response   Detect Outlier","\n")
cat(paste(format(DesY$y, width=8), format(DesYc$ycorr, width=13),
"           ", format(detect, width=10),"\n"),sep="")

# use LGB to test significance of effects calculated from corrected data

tce<-LGB(che)
```

```
  } else {
cat("Final Outlier Report","\n")
cat("No significant outlier detected in second pass","\n" )
# use LGB to test significance of effects calculated from corrected data
LGB(he)
cat("    ","\n")
         }

### End of second pass through the data #####
  }
}
# end of function Gaptest
 }
```

---

gear — *Unreplicated split-plot fractional-factorial experiment on geometric distortion of drive gears*

Description

Data from the unreplicated split-plot fractional-factorial experiment on geometric distortion of drive gears in chapter 8 of Design and Analysis of Experiments with R

Usage

```
data(gear)
```

Format

A data frame with 16 observations on the following 6 variables.

- `A` a factor with levels `-1 1`
- `B` a factor with levels `-1 1`
- `C` a factor with levels `-1 1`
- `P` a factor with levels `-1 1`
- `Q` a factor with levels `-1 1`
- `y` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(gear)
```

hardwood *low grade hardwood conjoint study*

Description

Data from the low grade hardwood conjoint study in chapter 6 of Design and Analysis of Experiments with R

Usage

```
data(hardwood)
```

Format

A data frame with 12 observations on the following 5 variables.

`Design` a factor with levels "RC" "AC" "OCI" "OCII"

`Price` a numeric variable

`Density` a factor with levels "Clear" "Heavy" "Medium"

`Guarantee` a factor with levels "1y" "Un"

`Rating` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(hardwood)
```

inject *Single array for injection molding experiment*

Description

Data from the single array for injection molding experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(inject)
```

Format

A data frame with 20 observations on the following 8 variables.

`A` a numeric vector

`B` a numeric vector

`C` a numeric vector

`D` a numeric vector

`E` a numeric vector

`F` a numeric vector

`G` a numeric vector

`shrinkage` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(inject)
```

`LGB` *Lawson, Grimshaw, Burt Test*

Description

This function uses the LGB method (based on the half normal plot) to test significance of effects in unreplicated orthogonal 2-level designs.

Usage

```
LGB<-function(Beta,alpha=.05,rpt=TRUE,plt=TRUE,pltl=TRUE)
```

Arguments

`Beta`	input - This is the the vector of effects or regression coefficients to be tested; it should not include the intercept. This function only works for vetors of length 7,8,11,15,16,26,31,32,35,63,or 127.
`alpha`	input - The significance level of the test. The only options available are .1, .05, .025, or .01, and the default is .05 if alpha is not specified.
`rpt`	input - logical, the default value is TRUE which indicates the report printout is desired.
`plt`	input - logical, the default value is TRUE which indicates the half-normal plot with reference line and significance limit is desired.
`pltl`	input - logical, the default value is TRUE which indicates the significance limit will be shown on the half-normal plot. Make pltl=FALSE, if you want to remove the significance limit line from the plot.

Value

The result is a vector of indicators "yes" or "no" for the significance of the coefficients in Beta at the alpha significance level.

Author(s)

John Lawson

References

Lawson, J., Grimshaw, S. and Burt, J. "A quantitative method for identifying active contrasts in unreplicated factorial experiments based on the half-normal plot" *Computational Statistics and Data Analysis* Vol 26, pages 425-436., 1998.

Examples

```
Beta<-c(.06,.25,-.01,.5,0,-.02,0,.14,.03,-.01,.02,.04,.02,.01,.02)
names(Beta)<-c("A","B","C","D","AB","AC","AD","BC","BD","CD","ABC","ABD","ACD","BCD","ABCD")
LGB(Beta,alpha=.05)


## The function is currently defined as
LGB<-function(Beta,alpha=.05,rpt=TRUE,plt=TRUE,pltl=TRUE) {
# function to compute the LGB statistic
siglev<-c(.1,.05,.025,.01)
df<-c(7,8,11,15,16, 17, 26, 31, 32, 35, 63, 127)
crittab<-matrix(c(1.265,1.196,1.161,1.122,1.110, 1.106, 1.072, 1.063, 1.060, 1.059, 1.037, 1.023,
1.534, 1.385, 1.291, 1.201, 1.186, 1.178, 1.115, 1.099, 1.093, 1.091, 1.056, 1.034,
1.889, 1.606, 1.449, 1.297, 1.274, 1.260, 1.165, 1.140, 1.130, 1.127, 1.074, 1.043,
2.506, 2.026, 1.74, 1.447, 1.421, 1.377, 1.232, 1.197, 1.185, 1.178, 1.096, 1.058),ncol=4,byrow=FALSE)
# get the critical value
colind<-which(siglev==alpha,arr.ind=TRUE)

if (length(colind)==0) {stop("this function works only when alpha= .1, .05, .025 or .01") }
rowind<-which(df==length(Beta),arr.ind=TRUE)
if (length(rowind)==0) {stop("this function works only for coefficent vectors of length
7,8,11,15,16,26,31,32,35,63,or 127")}

critL<-crittab[rowind,colind]

# calculate Beta1, Beta2 and the Rn statistic
acj<-abs(Beta)
ranks<-rank(acj,ties.method="first")
s0<-1.5*median(acj)
p<-(ranks-.5)/length(Beta)
z<-qnorm((p+1)/2)
moda<-lm(acj~-1+z)
beta1<-moda$coef
sel<-acj<2.5*s0
modi<-lm(acj[sel]~-1+z[sel])
beta2<-modi$coef
Rn<-beta1/beta2
# finds prediction limits for values in sorted absolute Beta
pred<-beta2*z
n<-length(acj[sel])
df<-n-1
```

```
sig<-sqrt(sum(modi$residuals^2)/df)
se.pred<-sig*(1+1/n+(z^2)/sum(z[sel]^2))^.5
pred.lim<-pred+qt(.975,df)*se.pred
# gets significance indicators
sigi<-c(rep("no",length(Beta)))
sel2<-acj>pred.lim
sigi[sel2]<-"yes"
 if (plt) {
plot(z,acj,xlab="Half Normal Scores", ylab="Absoulute Effects")
lines(sort(z),sort(pred),lty=1)

 for (i in 1:length(Beta)) {
   if (sigi[i]=="yes") text(z[i],acj[i],names(Beta)[i],pos=1)
                           }
 if (pltl) {
lines(sort(z),sort(pred.lim),lty=3)
           }
          }
 if (rpt) {
cat("Effect Report","\n")
cat("  ","\n")
cat("Label     Half Effect    Sig(.05)","\n")
cat(paste(format(names(Beta), width=8), format(Beta, width=8),
 "      ",format(sigi, width=10),"\n"),sep="")
cat("  ","\n")
cat("Lawson, Grimshaw & Burt Rn Statistic = ",Rn,"\n")
cat("95th percentile of Rn = ",critL,"\n")
          }
return(sigi)
                    }
```

`mod` *Mod function*

Description

Gets mod of a to base b

Usage

```
mod(a,b)
```

Arguments

a	input- an integer
b	input - an integer

Value

remainder of a/b or mod(a,b)

Author(s)

John Lawson

Examples

```
mod(5,3)
## The function is currently defined as
mod<-function(a,b)
{a-b*floor(a/b)}
```

`MPV` *mixture process variable experiment with mayonnaise*

Description

Data from the mixture process variable experiment with mayonnaise in chapter 11 of Design and Analysis of Experiments with R

Usage

```
data(MPV)
```

Format

A data frame with 35 observations on the following 4 variables.

`x1` a numeric vector

`x2` a numeric vector

`x3` a numeric vector

`z1` a numeric vector

`z2` a numeric vector

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(MPV)
```

`Naph` *Yields of naphthalene black*

Description

Data from the Yields of naphthalene black of Chapter 5 in Design and Analysis of Experiments with R

Usage

```
data(Naph)
```

Format

A data frame with 30 observations on the following 2 variables.

`sample` a factor with levels `1 2 3 4 5 6`

`yield` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(Naph)
```

`pastry` *Blocked response surface design for pastry dough experiment*

Description

Data from the Blocked response surface design for pastry dough experiment in chapter 10 of Design and Analysis of Experiments with R

Usage

```
data(pastry)
```

Format

A data frame with 28 observations on the following 5 variables.

`Block` a factor with levels `1 2 3 4 5 6 7`

`x1` a numeric vector

`x2` a numeric vector

`x3` a numeric vector

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(pastry)
```

`pest` *Pesticide formulation experiment*

Description

Data from the Pesticide formulation experiment in chapter 11 of Design and Analysis of Experiments with R

Usage

```
data(pest)
```

Format

A data frame with 13 observations on the following 4 variables.

`x1` a numeric vector

`x2` a numeric vector

`x3` a numeric vector

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(pest)
```

`pesticide` *pesticide application experiment*

Description

Data from the pesticide application experiment in chapter 5 of Design and Analysis of Experiments with R

Usage

```
data(pesticide)
```

Format

A data frame with 16 observations on the following 4 variables.

`form` a factor with levels `A` `B`

`tech` a factor with levels `1` `2`

`plot` a factor with levels `1` `2`

`residue` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(pesticide)
```

`plasma` *Unreplicated split-plot* 2^5 *experiment on plasma treatment of paper*

Description

Data from the unreplicated split-plot 2^5 experiment on plasma treatment of paper in chapter 8 of Design and Analysis of Experiments with R

Usage

```
data(plasma)
```

Format

A data frame with 32 observations on the following 6 variables.

`A` a factor with levels `-1` `1`

`B` a factor with levels `-1` `1`

`C` a factor with levels `-1` `1`

`D` a factor with levels `-1` `1`

`E` a factor with levels `-1` `1`

`y` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(plasma)
```

polvdat *Polvoron mixture experiment*

Description

Data from the Polvoron mixture experiment in chapter 11 of Design and Analysis of Experiments with R

Usage

```
data(polvdat)
```

Format

A data frame with 12 observations on the following 4 variables.

`x1` a numeric vector

`x2` a numeric vector

`x3` a numeric vector

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(polvdat)
```

polymer *polymerization strength variability study*

Description

Data from the polymerization strength variability study in chapter 5 of Design and Analysis of Experiments with R

Usage

```
data(polymer)
```

Format

A data frame with 120 observations on the following 5 variables.

`lot` a factor with levels `1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30`

`box` a factor with levels `1 2`

`prep` a factor with levels `1 2`

`test` a factor with levels `1 2`

`strength` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(polymer)
```

---

prodstd	*Complete control factor array and noise factor array for connector experiment*

Description

Data from the complete control factor array and noise factor array for connector experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(prodstd)
```

Format

A data frame with 16 observations on the following 16 variables.

`A` a numeric vector

`B` a numeric vector

`C` a numeric vector

`D` a numeric vector

`E` a numeric vector

`F` a numeric vector

`G` a numeric vector

`Pof` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(prodstd)
```

qsar *Library of substituted hydroxyphenylurea compounds*

Description

Data from the Library of substituted hydroxyphenylurea compounds in chapter 10 of Design and Analysis of Experiments with R (compact format)

Usage

```
data(qsar)
```

Format

A data frame with 36 observations on the following 4 variables.

`Compound` a numeric vector

`HE` a numeric vector

`DMz` a numeric vector

`S0K` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(qsar)
```

rcb *generalized RCB golf driving experiment*

Description

Data from the generalized RCB golf driving experiment in chapter 4 of Design and Analysis of Experiments with R

Usage

```
data(rcb)
```

Format

A data frame with 135 observations on the following 3 variables.

`id` a factor with levels `1 2 3 4 5 6 7 8 9`

`teehgt` a factor with levels `1 2 3`

`cdistance` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(rcb)
```

`residue` *Herbicide degradation experiment*

Description

Data from the Herbicide degradation experiment in chapter 9 of Design and Analysis of Experiments with R

Usage

```
data(residue)
```

Format

A data frame with 16 observations on the following 3 variables.

`soil` a factor with levels `"C"` `"P"`

`moisture` a factor with levels `"L"` `"H"`

`temp` a factor with levels `10` `30`

`X1` a numeric vector

`X2` a numeric vector

`X3` a numeric vector

`X4` a numeric vector

`X5` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(residue)
```

`rubber` *Rubber Elasticity data*

Description

Data from the Rubber Elasticity Study in chapter 5 of Design and Analysis of Experiments with R

Usage

```
data(rubber)
```

Format

A data frame with 96 observations on the following 4 variables.

`supplier` a factor with levels `A` `B` `C` `D`

`batch` a factor with levels `I` `II` `III` `IV`

`sample` a factor with levels `1` `2`

`elasticity` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(rubber)
```

`sausage` *Split-plot experiment on sausage casing with RCB in whole plot*

Description

Data from the Split-plot experiment on sausage casing with RCB in whole plot in chapter 7 of Design and Analysis of Experiments with R

Usage

```
data(sausage)
```

Format

A data frame with 32 observations on the following 5 variables.

`Block` a factor with levels `1` `2`

`Gbatch` a factor with levels `1` `2` `3` `4`

`A` a factor with levels `-1` `1`

`B` a factor with levels `-1` `1`

`C` a factor with levels `-1` `1`

`D` a factor with levels `-1` `1`

`ys` a numeric vector containing the response

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(sausage)
```

Smotor *Single array for starting motor experiment*

Description

Data from the single array for starting motor experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(Smotor)
```

Format

A data frame with 18 observations on the following 6 variables.

`A` a factor with levels `1` `2`

`B` a factor with levels `1` `2` `3`

`C` a factor with levels `1` `2` `3`

`D` a factor with levels `1` `2` `3`

`E` a factor with levels `1` `2`

`torque` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(Smotor)
```

soup *dry mix soup experiment*

Description

Data from the dry mix soup experiment in chapter 6 of Design and Analysis of Experiments with R

Usage

```
data(soup)
```

Format

A data frame with 16 observations on the following 6 variables.

- `A` a factor with levels `-1` `1`
- `B` a factor with levels `-1` `1`
- `C` a factor with levels `-1` `1`
- `D` a factor with levels `-1` `1`
- `E` a factor with levels `-1` `1`
- `y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(soup)
```

soupmx *dry soup mix variance component study*

Description

Data from the dry soup mix variance component study of Chapter 5 in Design and Analysis of Experiments with R

Usage

```
data(soupmx)
```

Format

A data frame with 12 observations on the following 2 variables.

- `batch` a factor with levels `1` `2` `3` `4`
- `weight` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(soupmx)
```

`splitPdes` *Split-plot cookie baking experiment*

Description

Data from the Split-plot cookie baking experiment in chapter 8 of Design and Analysis of Experiments with R

Usage

```
data(splitPdes)
```

Format

A data frame with 24 observations on the following 5 variables.

`short` a factor with levels `100` `80`

`trayT` a factor with levels `RoomT` `Hot`

`bakeT` a factor with levels `low` `mid` `high`

`batch` a factor with levels `1` `2`

`y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(splitPdes)
```

SPMPV *Split-plot mixture process variable experiment with vinyl*

Description

Data from the Split-plot mixture process variable experiment with vinyl in chapter 10 of Design and Analysis of Experiments with R

Usage

```
data(SPMPV)
```

Format

A data frame with 28 observations on the following 7 variables.

- `wp` a factor with levels `1` `2` `3` `4` `5` `6` `7`
- `z1` a numeric vector
- `z2` a numeric vector
- `x1` a numeric vector
- `x2` a numeric vector
- `x3` a numeric vector
- `y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(SPMPV)
```

strung *Repeated measures study with dairy cow diets*

Description

Data from the Repeated measures study with dairy cow diets in chapter 9 of Design and Analysis of Experiments with R (strung out format)

Usage

```
data(strung)
```

Format

A data frame with 120 observations on the following 5 variables.

- `Diet` a factor with levels `"Barley"` `"Mixed"` `"Lupins"`
- `Cow` a factor with levels `1` `2` `3` `4` `5` `6` `7` `8` `9` `10`
- `week` a factor with levels `1` `2` `3` `4`
- `protein` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(strung)
```

`strungtile` *Strung out control factor array and raw response data for Ina tile experiment*

Description

Data from the strung out control factor array and raw response data for Ina tile experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(strungtile)
```

Format

A data frame with 16 observations on the following 16 variables.

- `A` a numeric vector
- `B` a numeric vector
- `C` a numeric vector
- `D` a numeric vector
- `E` a numeric vector
- `F` a numeric vector
- `G` a numeric vector
- `H` a numeric vector
- `AH` a numeric vector
- `BH` a numeric vector
- `CH` a numeric vector
- `DH` a numeric vector
- `EH` a numeric vector
- `FH` a numeric vector
- `GH` a numeric vector
- `y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(strungtile)
```

`sugarbeet` *Sugarbeet data from Chapter 2*

Description

Sugarbeet data from chapter 2 of Design and Analysis of Experiments with R

Usage

```
data(sugarbeet)
```

Format

A data frame with 18 observations on the following 2 variables.

`treat` a factor with levels `A` `B` `C` `D`

`yield` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(sugarbeet)
```

`taste` *taste test panel experiment*

Description

Data from the taste test panel experiment in Chapter 7 of Design and Analysis of Experiments with R

Usage

```
data(taste)
```

Format

A data frame with 24 observations on the following 3 variables.

`panelist` a factor with levels `1` `2` `3` `4` `5` `6` `7` `8` `9` `10` `11` `12`

`recipe` a factor with levels `"A"` `"B"` `"C"` `"D"`

`score` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(taste)
```

---

teach *Teaching experiment data from Chapter 2*

Description

Data from the teaching experiment in chapter 2 of Design and Analysis of Experiments with R

Usage

```
data(teach)
```

Format

A data frame with 30 observations on the following 4 variables.

`class` a numeric vector

`method` a factor with levels `1` `2` `3`

`score` a factor with levels `1` `2` `3` `4` `5`

`count` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(teach)
```

Tet *Tetracycline concentration in plasma*

Description

Data from the Tetracycline concentration in plasma study in chapter 10 of Design and Analysis of Experiments with R (compact format)

Usage

```
data(Tet)
```

Format

A data frame with 9 observations on the following 2 variables.

`Time` a numeric vector

`Conc` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(Tet)
```

`tile` *Control factor array and summary statistics for Ina tile experiment*

Description

Data from the control factor array and summary statistics for Ina tile experiment in chapter 12 of Design and Analysis of Experiments with R

Usage

```
data(tile)
```

Format

A data frame with 8 observations on the following 11 variables.

`A` a numeric vector

`B` a numeric vector

`C` a numeric vector

`D` a numeric vector

`E` a numeric vector

`F` a numeric vector

`G` a numeric vector

`y1` a numeric vector

`y2` a numeric vector

`ybar` a numeric vector

`lns2` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(tile)
```

`Treb` — *Box-Behnken design for trebuchet experiment*

Description

Data from the Box-Behnken design for trebuchet experiment in chapter 10 of Design and Analysis of Experiments with R

Usage

```
data(Treb)
```

Format

A data frame with 15 observations on the following 4 variables.

- `x1` a numeric vector
- `x2` a numeric vector
- `x3` a numeric vector
- `y` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(Treb)
```

`Tukey1df` — *Tukey's single degree of freedom test for additivity*

Description

This function performs Tukey's single degree of freedom test for additivity in an unreplicated two-factor factorial.

Usage

```
Tukey1df<-function(data)
```

Arguments

`data`	input - This is a data frame containing an unreplicated two-factor factorial. The first column should be an numeric response, the second and third columns should be factors. At least one of the factors should have more than 2 levels.

Author(s)

John Lawson

References

Tukey, J. "One degree of freedom test for non-additivity" *Biometrics* Vol 5, pages 232-242., 1949.

Examples

```
Dilution<-rep(c(3,4,5),6)
Sample<-rep(c(1,2,3,4,5,6),each=3)
 y<-c(1.87506,1.38021,0.60206,1.74036,1.36173,0.90309,1.79934,1.25527,0.95424,2.02119,1.39794,1.000,1.7993
 virus<-data.frame(y=y, Sample=factor(Sample),Dilution=factor(Dilution))

Tukey1df(virus)


## The function is currently defined as
Tukey1df<-function(data) {
y<-data[,1]
Afactor<-data[,2]
Bfactor<-data[,3]
tst1<-is.factor(Afactor)
tst2<-is.factor(Bfactor)
tst3<-is.numeric(y)
if (tst1&tst2&tst3) {
a<-nlevels(Afactor)
b<-nlevels(Bfactor)
  }  else {stop("The first column of the data frame is the numeric response, the 2nd and 3rd columns shoul
tst4<-max(a,b)>2
tst5<-length(y)==a*b
if (tst4&tst5) {
ybb<-with(data, tapply(y, Bfactor, mean))
yba<-with(data, tapply(y, Afactor, mean))
sbb<-with(data, tapply(y, Bfactor, sum))
sba<-with(data, tapply(y, Afactor, sum))
ybardd<-mean(y)
CT<-(sum(y)^2)/(a*b)
ssA<-sum(sba^2/b)-CT
ssB<-sum(sbb^2/a)-CT
ssE<-sum(y^2)-CT-ssA-ssB
ybdj<-rep(ybb,6)
prody<-y*ybdj
sumprod<-tapply(prody,Afactor,sum)
leftsum<-sum(sumprod*yba)
ssAB<-(a*b*(leftsum-(ssA+ssB+a*b*ybardd^2)*ybardd)^2/(ssA*ssB))
ssR<-ssE-ssAB
F<-ssAB/(ssR/((a-1)*(b-1)-1))
Pval<-1-pf(1,((a-1)*(b-1)-1),F)
cat("Source           df     SS        MS        F     Pr>F","\n")
cat("A               ",paste(format(a-1, width=6)," ", format(round(ssA,4),justify="right"),"  ",format(round
cat("B               ",paste(format(b-1, width=6)," ", format(round(ssB,4),justify="right"),"  ",format(round
cat("Error           ",paste(format((b-1)*(a-1), width=6)," ", format(round(ssE,4),justify="right"),"  ",forma
cat("NonAdditivity",paste(format(1, width=6)," ", format(round(ssAB,4),justify="right"),"  ",format(round(
cat("Residual        ",paste(format((b-1)*(a-1)-1, width=6)," ", format(round(ssR,4),justify="right"),"  ",fo
   } else {stop("This function only works for unreplicated 2-factor factorials with >2 levels for one of t
}
```

`vci` *confidence limits for method of moments estimators of variance components*

Description

function for getting confidence intervals on variance components estimated by the method of moments

Usage

```
vci(confl,c1,ms1,nu1,c2,ms2,nu2)
```

Arguments

`confl`	input- confidence level
`c1`	input - linear combination coefficient of ms1 in the estimated variance component
`ms1`	input - Anova mean square 1
`nu1`	input - Anova degrees of freedom for mean square 1
`c2`	input - linear combination coefficient of ms2 in the estimated variance component
`ms2`	input - Anova mean square 2
`nu2`	input - Anova degrees of freedom for mean square 2

Value

returned delta, Lower and Upper limits

Author(s)

John Lawson

Examples

```
vci(.90,.05,.014852,2,.05,.026885,18)
## The function is currently defined as
vci<-function(confl,c1,ms1,nu1,c2,ms2,nu2){
  delta<-c1*ms1-c2*ms2
  alpha<-1-confl
  Falpha1<-qf(confl,nu1,10000000)
  Falpha12<-qf(confl,nu1,nu2)
  Fconf2<-qf(alpha,nu2,10000000)
  Fconf12<-qf(alpha,nu1,nu2)
  Falpha2<-qf(confl,nu2,10000000)
  Fconf1<-qf(alpha,nu1,10000000)
  Fconf12<-qf(alpha,nu1,nu2)
  G1<-1-(1/Falpha1)
  H2<-(1/Fconf2)-1
  G12<-((Falpha12-1)**2-G1**2*Falpha12**2-H2**2)/Falpha12
  VL<-G1**2*c1**2*ms1**2+H2**2*c2**2*ms2**2+G12*c1*c2*ms1*ms2
```

```
  H1<-(1/Fconf1)-1
  G2<-1-(1/Falpha2)
  H12<-((1-Fconf12)**2-H1**2*Fconf12**2-G2**2)/Fconf12
  VU<-H1**2*c1**2*ms1**2+G2**2*c2**2*ms2**2
  L<-delta-sqrt(VL)
  U<-delta+sqrt(VU)
  cat("delta=",delta," Lower Limit=",L," Upper Limit=",U,"\n")
}
```

`virus` *Assay of Viral Contamination experiment data from Chapter 3*

Description

Data from the Assay of Viral Contamination experiment in chapter 3 of Design and Analysis of Experiments with R

Usage

```
data(virus)
```

Format

A data frame with 18 observations on the following 3 variables.

`y` a numeric vector

`Sample` a factor with levels `1 2 3 4 5 6`

`Dilution` a factor with levels `3 4 5`

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(virus)
```

`volt` *Volt meter experiment data from Chapter 3*

Description

Data from the Volt meter experiment in chapter 3 of Design and Analysis of Experiments with R

Usage

```
data(volt)
```

Format

A data frame with 16 observations on the following 3 variables.

`y` a numeric vector

`XA` a numeric vector containing the coded levels (-1,1) of factor A

`XB` a numeric vector containing the coded levels (-1,1) of factor B

`XC` a numeric vector containing the coded levels (-1,1) of factor C

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(volt)
```

`web` *Web page design experiment data from Chapter 3*

Description

Data from the web page design experiment in chapter 3 of Design and Analysis of Experiments with R

Usage

```
data(web)
```

Format

A data frame with 36 observations on the following 6 variables.

`A` a factor with levels `1` `2`

`B` a factor with levels `1` `2`

`C` a factor with levels `1` `2`

`D` a factor with levels `1` `2`

`visitors` a numeric vector

`signup` a numeric vector

Source

Design and Analysis of Experiments with R, by John Lawson, CRC/Chapman Hall

Examples

```
data(web)
```

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