Package: easyanova (via r-universe)

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Type Package

Title Analysis of Variance and Other Important Complementary Analyses

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Description Perform analysis of variance and other important complementary analyses. The functions are easy to use. Performs analysis in various designs, with balanced and unbalanced data.

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`easyanova-package` *Analysis of Variance and Other Important Complementary Analyzes*

Description

Perform analysis of variance and other important complementary analyzes. The functions are easy to use. Performs analysis in various designs, with balanced and unbalanced data.

Details

Package:	easyanova
Type:	Package
Version:	11.0
Date:	2024-09-14
License:	GPL-2

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

CRUZ, C.D. and CARNEIRO, P.C.S. Modelos biometricos aplicados ao melhoramento genetico. 2nd Edition. Vicosa, UFV, v.2, 2006. 585p.

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

SAMPAIO, I. B. M. Estatistica aplicada a experimentacao animal. 3nd Edition. Belo Horizonte: Editora FEPMVZ, Fundacao de Ensino e Pesquisa em Medicina Veterinaria e Zootecnia, 2010. 264p.

SANDERS W.L. and GAYNOR, P.J. Analysis of switchback data using Statistical Analysis System, Inc. Software. Journal of Dairy Science, 70.2186-2191. 1987.

PIMENTEL-GOMES, F. and GARCIA C.H. Estatistica aplicada a experimentos agronomicos e florestais: exposicao com exemplos e orientacoes para uso de aplicativos. Editora Fealq, v.11, 2002. 309p.

RAMALHO, M. A. P.; FERREIRA, D. F. and OLIVEIRA, A. C. Experimentacao em Genetica e Melhoramento de Plantas. Editora UFLA, 2005, 322p.

See Also

ea1, ea2, ec

Examples

```
# Kaps and Lamberson(2009)
data(data1)
data(data2)
data(data3)
data(data4)

# analysis in completely randomized design
r1<-ea1(data1, design=1)

names(r1)

r1

# analysis in randomized block design
r2<-ea1(data2, design=2)

# analysis in latin square design
r3<-ea1(data3, design=3)

# analysis in several latin squares design
r4<-ea1(data4, design=4)

r1[1]
r2[1]
r3[1]
r4[1]
```

```
# analysis in unbalanced randomized block design
response<-ifelse(data2$Gain>850, NA, data2$Gain)
ndata<-data.frame(data2[-3],response)
ndata

r5<-ea1(ndata, design=2 )

r5

# multivariable response (list argument = TRUE)
t<-c('a','a','a','b','b','b','c','c','c')
r1<-c(10,12,12.8,4,6,8,14,15,16)
r2<-c(102,105,106,125,123,124,99,95,96)
r3<-c(560,589,590,658,678,629,369,389,378)


d<-data.frame(t,r1,r2,r3)

results=ea1(d, design=1, list=TRUE)
names(results)
results

results[1][[1]]

names(results[1][[1]])
```

`box.plot` *Box plot*

Description

Plot quartis

Usage

```
box.plot(data,test=1, xlab=NULL, ylab=NULL,legend=TRUE,
letters=TRUE, family="Times", bg="white",  cex.axis=0.7,...)
```

Arguments

`data`	data.frame with data (see examples)
`test`	type of test 1 = Kruskall-Wallis 2 = Friedman
`xlab`	name of x-axis
`ylab`	name of y-axis
`legend`	TRUE = plot p-value of test FALSE = not plot p-value
`letters`	TRUE = plot letters FALSE = not plot letters

family	font of plot
bg	background color
cex.axis	font size in the axis
...	more plot parameters

Value

Returns box plots and test of Kruskall-Wallis and Friedman

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2, means.plot

Examples

```
#data3: Kaps and Lamberson (2009)
#Description:
##The experiment compared three diets for pigs in a completely randomized design
data(data1)

# Kruskal-Wallis test
box.plot(data1, test=1)

#Description
#Complete randomized block design to determine the average daily gain of steers
data(data2)
box.plot(data2, test=2)

#More plot parameters
box.plot(data2, test=2, col=c(2,7,3), col.axis="red",las=1,
legend=FALSE, bg="cornsilk", sub="Treatments", cex=1.2);grid(10, lwd=1.5)
```

`data1` *data1: Kaps and Lamberson(2009): page 252*

Description

The experiment compared three diets for pigs in a completely randomized design

Usage

```
data(data1)
```

Format

A data frame with 15 observations on the following 2 variables.

`Diet` a factor with levels `d1` `d2` `d3`

`Gain` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data1)
summary(data1)
```

`data10` *data10: Kaps and Lamberson (2009): page 395*

Description

Completely randomized design with a covariate.The effect of three diets on daily gain of steers was investigated. The design was a completely randomized design. Weight at the beginning of the experiment (initial weight) was recorded, but not used in the assignment of animals to diet.

Usage

```
data(data10)
```

Format

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

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

`Initial_weight` a numeric vector

`Repetitions` a numeric vector

`Gain` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data10)
summary(data10)
```

`data11` *data11: Pimentel Gomes and Garcia (2002): page 199*

Description

Incomplete block design

Usage

```
data(data11)
```

Format

A data frame with 56 observations on the following 4 variables.

`treatments` a numeric vector

`rep` a numeric vector

`blocks` a numeric vector

`yield` a numeric vector

References

PIMENTEL-GOMES, F. and GARCIA C.H. Estatistica aplicada a experimentos agronomicos e florestais: exposicao com exemplos e orientacoes para uso de aplicativos. Editora Fealq, v.11, 2002. 309p.

Examples

```
data(data11)
summary(data11)
```

data12 *data12: Pimentel Gomes and Garcia (2002): page 202*

Description

Incomplete block design

Usage

```
data(data12)
```

Format

A data frame with 42 observations on the following 4 variables.

`treatments` a numeric vector

`rep` a numeric vector

`blocks` a numeric vector

`yield` a numeric vector

References

PIMENTEL-GOMES, F. and GARCIA C.H. Estatistica aplicada a experimentos agronomicos e florestais: exposicao com exemplos e orientacoes para uso de aplicativos. Editora Fealq, v.11, 2002. 309p.

Examples

```
data(data12)
summary(data12)
```

data13 *data13: Cruz and Carneiro (2006): page 575*

Description

Incomplete block design

Usage

```
data(data13)
```

Format

A data frame with 23 observations on the following 3 variables.

`genotypes` a factor with levels `f1` `f10` `f11` `f12` `f13` `f14` `f2` `f3` `f4` `f5` `f6` `f7` `f8` `f9` `test1` `test2` `test3`

`blocks` a factor with levels `b1` `b2` `b3`

`yield` a numeric vector

References

CRUZ, C.D. and CARNEIRO, P.C.S. Modelos biometricos aplicados ao melhoramento genetico. 2nd Edition. Vicosa, UFV, v.2, 2006. 585p.

Examples

```
data(data13)
summary(data13)
```

---

data14 — *data14: Sampaio (2009): page173*

Description

Incomplete block design in animals

Usage

```
data(data14)
```

Format

A data frame with 28 observations on the following 4 variables.

`treatment` a factor with levels `A` `B` `C` `D` `E` `F` `G`

`animal` a factor with levels `A1` `A2` `A3` `A4` `A5` `A6` `A7`

`period` a factor with levels `P1` `P2` `P3` `P4`

`response` a numeric vector

References

SAMPAIO, I. B. M. Estatistica aplicada a experimentacao animal. 3nd Edition. Belo Horizonte: Editora FEPMVZ, Fundacao de Ensino e Pesquisa em Medicina Veterinaria e Zootecnia, 2010. 264p.

Examples

```
data(data14)
summary(data14)
```

`data15` *data15: Pimentel Gomes and Garcia (2002): page 211*

Description

Lattice design

Usage

```
data(data15)
```

Format

A data frame with 48 observations on the following 4 variables.

`treatments` a numeric vector

`rep` a numeric vector

`blocks` a numeric vector

`yield` a numeric vector

References

PIMENTEL-GOMES, F. and GARCIA C.H. Estatistica aplicada a experimentos agronomicos e florestais: exposicao com exemplos e orientacoes para uso de aplicativos. Editora Fealq, v.11, 2002. 309p.

Examples

```
data(data15)
summary(data15)
```

`data16` *data16: Sampaio (2010): page164*

Description

Switchback design

Usage

```
data(data16)
```

Format

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

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

`period` a numeric vector

`animal` a numeric vector

`gain` a numeric vector

References

SAMPAIO, I. B. M. Estatistica aplicada a experimentacao animal. 3nd Edition. Belo Horizonte: Editora FEPMVZ, Fundacao de Ensino e Pesquisa em Medicina Veterinaria e Zootecnia, 2010. 264p.

Examples

```
data(data16)
summary(data16)
```

`data17` *data17: Sanders and Gaynor (1987)*

Description

Switchback design

Usage

```
data(data17)
```

Format

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

`treatments` a numeric vector

`blocks` a factor with levels `b1` `b2` `b3`

`period` a numeric vector

`animal` a numeric vector

`gain` a numeric vector

References

SANDERS W.L. and GAYNOR, P.J. Analysis of switchback data using Statistical Analysis System, Inc. Software. Journal of Dairy Science, 70.2186-2191. 1987.

Examples

```
data(data17)
summary(data17)
```

data18 — *data18: Ramalho et al. (2005): page 115*

Description

Repetition of experiments in block design

Usage

```
data(data18)
```

Format

A data frame with 60 observations on the following 4 variables.

`treatments` a numeric vector

`experiments` a numeric vector

`blocks` a numeric vector

`response` a numeric vector

References

RAMALHO, M. A. P.; FERREIRA, D. F. and OLIVEIRA, A. C. Experimentacao em Genetica e Melhoramento de Plantas. Editora UFLA, 2005, 322p.

Examples

```
data(data18)
summary(data18)
```

data19 — *data19: Sampaio (2010): page 155*

Description

Repetition of latin square design

Usage

```
data(data19)
```

Format

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

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

`squares` a factor with levels `1` `2`

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

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

`response` a numeric vector

References

SAMPAIO, I. B. M. Estatistica aplicada a experimentacao animal. 3nd Edition. Belo Horizonte: Editora FEPMVZ, Fundacao de Ensino e Pesquisa em Medicina Veterinaria e Zootecnia, 2010. 264p.

Examples

```
data(data19)
summary(data19)
```

`data2` *data2: Kaps and Lamberson (2009): page 313: randomizad block design*

Description

Complete randomized block design to determine the average daily gain of steers

Usage

```
data(data2)
```

Format

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

`Treatments` a factor with levels `t1` `t2` `t3`

`Blocks` a factor with levels `b1` `b2` `b3` `b4`

`Gain` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data2)
summary(data2)
```

data3 *data3: Kaps and Lamberson (2009): page 347*

Description

Latin square design for test four different treatments on hay intake of fattening steers

Usage

```
data(data3)
```

Format

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

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

`period` a factor with levels `p1` `p2` `p3` `p4`

`steer` a factor with levels `a1` `a2` `a3` `a4`

`response` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data3)
summary(data3)
```

data4 *data4: Kaps and Lamberson (2009): page 349*

Description

Two latin squares design for test four different treatments on hay intake of fattening steers

Usage

```
data(data4)
```

Format

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

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

`square` a numeric vector

`steer` a numeric vector

`period` a numeric vector

`response` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data4)
summary(data4)
```

---

data5 *data5: Kaps and Lamberson (2009): page 361*

Description

Factorial in randomized design for testing two vitamins in feed of pigs

Usage

```
data(data5)
```

Format

A data frame with 20 observations on the following 3 variables.

`Vitamin_1` a numeric vector

`Vitamin_2` a numeric vector

`Gains` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data5)
summary(data5)
```

`data6` *data6: Pimentel Gomes and Garcia (2002): page 127*

Description

Factorial in randomized block design

Usage

```
data(data6)
```

Format

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

`factor1` a numeric vector

`factor2` a numeric vector

`block` a numeric vector

`yield` a numeric vector

References

PIMENTEL-GOMES, F. and GARCIA C.H. Estatistica aplicada a experimentos agronomicos e florestais: exposicao com exemplos e orientacoes para uso de aplicativos. Editora Fealq, v.11, 2002. 309p.

Examples

```
data(data6)
summary(data6)
```

`data7` *data7: Kaps and Lamberson (2009): page 409*

Description

The aim of this experiment was to test the difference between two treatments on gain of kids. A sample of 18 kids was chosen, nine for each treatment. One kid in treatment 1 was removed from the experiment due to illness. The experiment began at the age of 8 weeks. Weekly gain was measured at ages 9, 10, 11 and 12 weeks.

Usage

```
data(data7)
```

Format

A data frame with 68 observations on the following 4 variables.

`treatment` a character vector

`rep` a numeric vector

`week` a character vector

`gain` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data7)
summary(data7)
```

---

data8 — *data8: Kaps and Lamberson (2009): page 386*

Description

Split-plot Design. Main Plots in Randomized Blocks. An experiment was conducted in order to investigate four different treatments of pasture and two mineral supplements on milk yield. The total number of cows available was 24. The experiment was designed as a split-plot, with pasture treatments (factor A) assigned to the main plots and mineral supplements (factor B) assigned to split-plots. The experiment was replicated in three blocks.

Usage

```
data(data8)
```

Format

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

`pasture` a factor with levels `p1` `p2` `p3` `p4`

`block` a numeric vector

`mineral` a factor with levels `m1` `m2`

`milk` a numeric vector

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

Examples

```
data(data8)
summary(data8)
```

---

data9 *data9: Sampaio (2010): page 67*

Description

Factorial design to evaluate egg quality according to the lineage of chicken, packaging and storage time.

Usage

```
data(data9)
```

Format

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

`lineage` a factor with levels `A` `B`

`packing` a factor with levels `Ce` `Co` `S`

`time` a numeric vector

`repetitions` a numeric vector

`response` a numeric vector

References

SAMPAIO, I. B. M. Estatistica aplicada a experimentacao animal. 3nd Edition. Belo Horizonte: Editora FEPMVZ, Fundacao de Ensino e Pesquisa em Medicina Veterinaria e Zootecnia, 2010. 264p.

Examples

```
data(data9)
summary(data9)
```

ea1 *Analysis of variance in simple designs*

Description

Perform analysis of variance and other important complementary analyzes. The function are easy to use. Performs analysis in various simples designs, with balanced and unbalanced data. Too performs analysis the kruskal-Wallis and Friedman (designs 14 and 15).

Usage

```
ea1(data, design = 1, alpha = 0.05, list = FALSE, p.adjust=1, plot=2)
```

Arguments

`data`	data is a data.frame see how the input data in the examples
`design`	1 = completely randomized design 2 = randomized block design 3 = latin square design 4 = several latin squares 5 = analysis with a covariate (completely randomized design) 6 = analysis with a covariate (randomized block design) 7 = incomplete blocks type I and II 8 = incomplete blocks type III or augmented blocks 9 = incomplete blocks type III in animal experiments 10 = lattice (intra-block analysis) 11 = lattice (inter-block analysis) 12 = switchback design 13 = switchback design in blocks 14 = Kruskal-Wallis rank sum test 15 = Friedman rank sum test
`alpha`	significance level for multiple comparisons
`list`	FALSE = a single response variable TRUE = multivariable response
`p.adjust`	1="none"; 2="holm"; 3="hochberg"; 4="hommel"; 5="bonferroni"; 6="BH", 7="BY"; 8="fdr"; for more details see function "p.adjust"
`plot`	1 = box plot for residuals; 2 = standardized residuals vs sequence data; 3 = standardized residuals vs theoretical quantiles

Details

The response variable must be numeric. Other variables can be numeric or factors.

Value

Returns analysis of variance, means (adjusted means), multiple comparison test (tukey, snk, duncan, t and scott knott) and residual analysis. Too returns analysis the kruskal-Wallis and Friedman (designs 14 and 15).

Author(s)

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References

CRUZ, C.D. and CARNEIRO, P.C.S. Modelos biometricos aplicados ao melhoramento genetico. 2nd Edition. Vicosa, UFV, v.2, 2006. 585p.

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

SAMPAIO, I. B. M. Estatistica aplicada a experimentacao animal. 3nd Edition. Belo Horizonte: Editora FEPMVZ, Fundacao de Ensino e Pesquisa em Medicina Veterinaria e Zootecnia, 2010. 264p.

SANDERS W.L. and GAYNOR, P.J. Analysis of switchback data using Statistical Analysis System, Inc. Software. Journal of Dairy Science, 70.2186-2191. 1987.

PIMENTEL-GOMES, F. and GARCIA C.H. Estatistica aplicada a experimentos agronomicos e florestais: exposicao com exemplos e orientacoes para uso de aplicativos. Editora Fealq, v.11, 2002. 309p.

See Also

ea2, ec

Examples

```
# Kaps and Lamberson(2009)
data(data1)
data(data2)
data(data3)
data(data4)

# analysis in completely randomized design
r1<-ea1(data1, design=1)

names(r1)

r1

# analysis in randomized block design
r2<-ea1(data2, design=2)

# analysis in latin square design
r3<-ea1(data3, design=3)
```

```
# analysis in several latin squares design
r4<-ea1(data4, design=4)

r1[1]
r2[1]
r3[1]
r4[1]

# analysis in unbalanced randomized block design
response<-ifelse(data2$Gain>850, NA, data2$Gain)
ndata<-data.frame(data2[-3],response)
ndata

r5<-ea1(ndata, design=2 )

r5

# multivariable response (list argument = TRUE)
t<-c('a','a','a','b','b','b','c','c','c')
r1<-c(10,12,12.8,4,6,8,14,15,16)
r2<-c(102,105,106,125,123,124,99,95,96)
r3<-c(560,589,590,658,678,629,369,389,378)


d<-data.frame(t,r1,r2,r3)

results=ea1(d, design=1, list=TRUE)
names(results)
results

results[1][[1]]

names(results[1][[1]])

# analysis with a covariate
# Kaps and Lamberson (2009)
data(data10)

# analysis in completely randomized design
r6<-ea1(data10[-3], design=5)

r6


# incomplete blocks type I and II
# Pimentel Gomes and Garcia (2002)
data(data11)
data(data12)

r7<-ea1(data11,design=7)
r8<-ea1(data12,design=7)

r7;r8
```

```
# incomplete blocks type III or augmented blocks
# Cruz and Carneiro (2006)
data(data13)

r9<-ea1(data13, design=8)
r9



# incomplete blocks type III in animal experiments
# Sampaio (2010)
data(data14)

r10<-ea1(data14, design=9)
r10

# lattice
# Pimentel Gomes and Garcia (2002)
data(data15)

r11<-ea1(data15, design=10) # intra-block analysis
r12<-ea1(data15, design=11) # inter-block analysis

r11
r12

# switchback design
# Sampaio (2010)
data(data16)
r13<-ea1(data16, design=12)
r13

# switchback design in blocks
# Sanders and Gaynor (1987)
data(data17)
r14<-ea1(data17, design=13)
r14

#Kruskal-Wallis Rank Sum Test
r15<-ea1(data1, design=14)
r15

#Friedman Rank Sum Test
r16<-ea1(data2, design=15)
r16


# Graeco-Latin Square
#latin letters
treatment=c("A","B","C","D","E","B","C","D","E","A","C",
"D","E","A","B","D","E","A","B","C","E","A","B","C","D")
```

```
##blocked factors
#greek letters
block=c(1,2,3,4,5,3,4,5,1,2,5,1,2,3,4,2,3,4,5,1,4,5,1,2,3)
# rowns
rows=rep(1:5,5)
#coluns
columns=rep(1:5, each=5)
#variable
response=c(-1,-8,-7,1,-3,-5,-1,13,6,5,-6,5,1,1,-5,-1,2,2,-2,4,-1,11,-4,-3,6)
# table
data=data.frame(treatment, block, rows, columns, response)
r16=ea1(data, design=16)
r16

### Repetitions of Graeco-Latin Square
#latin letters
treatment=c("A","B","C","D","E","B","C","D","E",
"A","C","D","E","A","B","D","E","A","B","C","E","A","B","C","D",
"A","B","C","D","E","B","C","D","E","A","C","D",
"E","A","B","D","E","A","B","C","E","A","B","C","D")
#squares
squares=rep(1:2,25)
##blocked factors
#greek letters
block=c(1,2,3,4,5,3,4,5,1,2,5,1,2,3,4,2,3,4,5,1,4,5,1,2,3,
1,2,3,4,5,3,4,5,1,2,5,1,2,3,4,2,3,4,5,1,4,5,1,2,3)
# rowns
rows=c(rep(1:5,5),rep(1:5,5))
#coluns
columns=c(rep(1:5, each=5),rep(1:5, each=5))
#variable
response=c(-1,-8,-7,1,-3,-5,-1,13,6,5,-6,5,1,1,-5,-1,2,2,-2,4,-1,11,-4,-3,6,
-2,-9,-8,1,-2,-5,-1,9,6,5,-5,2,3,1,-7,-1,2,4,-1,2,-2,15,-5,-1,7)

# table
data=data.frame(treatment, squares, block, rows, columns, response)
r17=ea1(data, design=17)
r17
```

---

ea2 — *Analysis of variance in factorial and split plot*

Description

Perform analysis of variance and other important complementary analyzes in factorial and split plot scheme, with balanced and unbalanced data.

Usage

```
ea2(data, design = 1, alpha = 0.05, cov = 4, list = FALSE, p.adjust=1, plot=2)
```

Arguments

`data`	data is a data.frame see how the input data in the examples
`design`	1 = double factorial in completely randomized design 2 = double factorial in randomized block design 3 = double factorial in latin square design 4 = split plot in completely randomized design 5 = split plot in randomized block design 6 = split plot in latin square design 7 = triple factorial in completely randomized design 8 = triple factorial in randomized block design 9 = double factorial in split plot (completely randomized) 10 = double factorial in split plot (randomized in block) 11 = joint analysis of experiments with hierarchical blocks 12 = joint analysis of repetitions of latin squares (hierarchical rows) 13 = joint analysis of repetitions of latin squares (hierarchical rows and columns)
`alpha`	significance level for multiple comparisons
`cov`	for split plot designs 1 = Autoregressive 2 = Heterogenius Autoregressive 3 = Continuous Autoregressive Process 4 = Compound Symetry 5 = Unstructured
`list`	FALSE = a single response variable TRUE = multivariable response
`p.adjust`	1="none"; 2="holm"; 3="hochberg"; 4="hommel"; 5="bonferroni"; 6="BH", 7="BY"; 8="fdr"; for more details see function "p.adjust"
`plot`	1 = box plot for residuals; 2 = standardized residuals vs sequence data; 3 = standardized residuals vs theoretical quantiles

Details

The response variable must be numeric. Other variables can be numeric or factors.

Value

Returns analysis of variance, means (adjusted means), multiple comparison test (tukey, snk, duncan, t and scott knott) and residual analysis.

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

SAMPAIO, I. B. M. Estatistica aplicada a experimentacao animal. 3nd Edition. Belo Horizonte: Editora FEPMVZ, Fundacao de Ensino e Pesquisa em Medicina Veterinaria e Zootecnia, 2010. 264p.

PIMENTEL-GOMES, F. and GARCIA C.H. Estatistica aplicada a experimentos agronomicos e florestais: exposicao com exemplos e orientacoes para uso de aplicativos. Editora Fealq, v.11, 2002. 309p.

RAMALHO, M. A. P.; FERREIRA, D. F. and OLIVEIRA, A. C. Experimentacao em Genetica e Melhoramento de Plantas. Editora UFLA, 2005, 322p.

See Also

ea1, ec

Examples

```
# double factorial

# completely randomized design
data(data5)
r1=ea2(data5, design=1)
r1

# randomized block design
# data(data6)
# r2=ea2(data6, design=2)
# r2

# names(r1)

# names(r2)

# triple factorial

# completely randomized design
# data(data9)
# r3=ea2(data9[,-4], design=7)
# r3[1]


# split plot

# completely randomized design
# data(data7)
```

```
# r4=ea2(data7, design=4)
# r4

# randomized block design
# data(data8)
# r5=ea2(data8, design=5)
# r5

# hierarchical blocks
# Ramalho et al. (2005)
# data(data18)
# data18
# r6=ea2(data18, design=11)
# r6

# hierarchical latin squares
# Sampaio (2010)
# data(data19)
# data19
# r7=ea2(data19, design=12)
# r8=ea2(data19, design=13)

# hierarchical rows
# r7

# hierarchical rows and columns
# r8

#split.plot in latin square
        #data(data3)
        #d=rbind(data3,data3)
        #d=data3[,-4];d=data.frame(d,time=rep(1:2,each=16),response=rnorm(32,45,4))
# r9=ea2(d,design=6)
# r9
```

`ec` *Easy contrast*

Description

Performs contrasts of means

Usage

```
ec(mg1, mg2, sdg1, sdg2, df)
```

Arguments

mg1	Means of the group 1
mg2	Means of the group 2

sdg1	Standard error of the group 1
sdg2	Standard error of the group 2
df	Degree of freedom from error

Value

Returns t test for contrast

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2

Examples

```
# Kaps and Lamberson(2009, pg 254)

data(data1)

r<-ea1(data1, design=1)
r[2]

# first contrast
mg1=312;mg2=c(278,280); sdg1=7.7028;sdg2=c(7.7028,7.7028); df=12
ec(mg1,mg2,sdg1,sdg2,df)

# second contrast
mg1=280;mg2=278; sdg1=7.7028;sdg2=7.7028; df=12
ec(mg1,mg2,sdg1,sdg2,df)
```

---

ic *Confidence intervals of contrasts*

Description

Estimate of confidence intervals of the contrasts

Usage

```
ic(data, test=1, df=10, alpha=0.05)
```

Arguments

`data`	output object of ea1 or ea2 function (see examples)
`test`	Letters of the post-hoc test 1=Tukey 2=SNK 3=Duncan 4=t 5=Scott-Knott
`df`	degree of freedom of residuals in anova
`alpha`	significance level

Value

Returns confidence intervals of the contrasts

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2, box.plot, means.plot, means.plotfat, ic.plot, p.plot

Examples

```
#data3: Kaps and Lamberson (2009): page 347
#Description:
##Latin square design for test four different treatments on hay intake of fattening steers

data(data3)

r<-ea1(data3, design=3)


#plot
#means
means=r[[2]]
means
ic(means, test=1, df=6) # tukey

# alpha = 0.10
ic(r[[2]], test=1, df=6, alpha=0.10)


# split plot
data('data7')
r<-ea2(data7,4)

#plot
ic(r[2], df=15)
```

```
#split.plot
ic(r[4], df=45)
```

---

ic.plot *Plot confidence intervals of contrasts*

Description

Plot confidence intervals of contrasts

Usage

```
ic.plot(data,col="dark green", cex=0.5, xlab="constrats",
pch=19,family="Times", bg="white",...)
```

Arguments

data	output object of ic (see examples)
col	colours of lines
cex	size of points
xlab	title of x-axis
pch	type of points
family	font of plot
bg	background color
...	more plot parameters

Value

Plot confidence intervals of contrasts

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2, box.plot, means.plot, means.plotfat, ic.plot, p.plot

Examples

```
#data3: Kaps and Lamberson (2009): page 347
#Description:
##Latin square design for test four different treatments on hay intake of fattening steers

data(data3)

r<-ea1(data3, design=3)


#plot
#means
means=r[[2]]
means
ic(means, test=1, df=6) # tukey

#intervals
conf=ic(means, test=1, df=6)

#plot intervals
ic.plot(conf)

#more plot parameters
ic.plot(conf, las=2, bg="cornsilk");grid(10)
```

`m.plot` *Plot Means*

Description

Plot contrasts of means

Usage

```
m.plot(data,  s="sd",test="tukey", family="Times", bg="white",  cex.text=0.7,
cex=0.5,bar.order=2, decreasing=TRUE, xlab="treatments", ylab="",pch=19, ...)
```

Arguments

`data`	output object of ea1 or ea2 function (see examples)
`s`	s="sd" (defalt) plot standard deviation s="sem" plot standard error of mean
`test`	Letters of the post-hoc test test="tukey" (default) test="snk" test="duncan" test="t" test="scott_knott"
`family`	font of plot

bg	background color
cex.text	font size in letters and means
cex	font size in points
bar.order	order of bar or means 1 = order of treatments names 2 = order of the means (default)
decreasing	decreasing bar order (TRUE or FALSE)
xlab	title of x-axis
ylab	title of y-axis
pch	type of points
...	more plot parameters

Value

Returns plots of means

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2, box.plot, means.plot, means.plotfat, ic, ic.plot, p.plot

Examples

```
#data3: Kaps and Lamberson (2009): page 347
#Description:
##Latin square design for test four different treatments on hay intake of fattening steers

data(data3)

r<-ea1(data3, design=3)


#plot
#means
means=r[[2]]
means
m.plot(means, col=gray.colors(4))

#direct
m.plot(r[[2]], col=gray.colors(4))

# more graphical parameters
```

```
m.plot(means, col=c(2,7,3,5), bg="white", las=1, cex.text=1,main="Tukey (0.05)",
family="sans", bar.order=2, decreasing=FALSE);grid(10)

data('data7')
r<-ea2(data7,4)
m.plot(r[[4]], col=c(2,7,3,5), las=1, bg="cornsilk");grid(10)

par(mfrow=c(1,2))
m.plot(r[[8]][1], test="scott_knott",xlab="treatment 1",col=c(2,7,3,5),
las=2, bg="cornsilk",bar.order=2, decreasing=FALSE);grid(10)
m.plot(r[[8]][2], test="scott_knott",xlab="treatment 2", col=c(2,7,3,5),
las=2, bg="cornsilk", bar.order=2, decreasing=FALSE);grid(10)
```

`means.plot` *Plot Means*

Description

Plot contrasts of means

Usage

```
means.plot(data, plot=1, s=1,test=1, legend=TRUE, letters=TRUE,
family="Times", bg="white",cex.names=0.8, cex.text=0.7, cex.legend=1,
bar.order=2, decreasing=TRUE, alpha=0.05,cex=0.5, pch=19,  ...)
```

Arguments

`data`	output object of ea1 function (see examples)
`plot`	type of plot 1 = bar plot (default) 2 = means plot 3 = confidence interval of the contrasts
`s`	s=1 (defalt) plot standard deviation s=2 plot standard error of mean
`test`	Letters of the post-hoc test 1=Tukey 2=SNK 3=Duncan 4=t 5=Scott-Knott
`legend`	TRUE = plot p-value of F test FALSE = not plot p-value
`letters`	TRUE = plot letters FALSE = not plot letters
`family`	font of plot
`bg`	background color
`cex.names`	font size in names of treatments (x-axis)
`cex.text`	font size in letters and means
`cex.legend`	font size in legend
`bar.order`	order of bar or means 1 = order of treatments names 2 = order of the means (default)
`decreasing`	decreasing bar order (TRUE or FALSE)
`alpha`	0.05 (default) is the alpha of confidence intervals
`cex`	size of points
`pch`	type of points
`...`	more plot parameters

Value

Returns plots and confidence intervals

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2

Examples

```
#data3: Kaps and Lamberson (2009): page 347
#Description:
##Latin square design for test four different treatments on hay intake of fattening steers

data(data3)

r<-ea1(data3, design=3)


#plot
means.plot(r, col=gray.colors(4))

# more graphical parameters
means.plot(r, col=c(2,7,3,5), bg="cornsilk", las=1, cex.names=2,
sub="treatments", family="sans");grid(10)

# plot = 2
means.plot(r, plot=2, col="dark green", bg="gray", las=1, cex.names=2,
sub="Treatments", family="Times", ylab="Hay intake")

# plot = 2 decreasing =FALSE
means.plot(r, plot=2, las=1, cex.names=2, col="red",lty=2,pch=20,cex=1.1,
sub="Treatments", family="Times", ylab="Hay intake", decreasing=FALSE, legend=FALSE);grid(10)

# plot=3
means.plot(r, plot=3, las=1, cex.names=2,
sub="Contrasts (Tukey 0.05)", family="Times", ylab="")

# plot=3  alpha=0.10
means.plot(ea1(data3, design=3), plot=3, las=2, cex.names=2,
sub="Contrasts (Tukey 0.10)", family="Times", ylab="", alpha=0.10, bg="cornsilk");grid(10)
```

`means.plotfat` *Plot Means (interactions)*

Description

Plot contrasts of means

Usage

```
means.plotfat(data, plot=1, s=1,test=1, legend=TRUE, letters=TRUE,
family="Times", bg="white",  cex.names=0.8, cex.text=0.7,
 cex.legend=1, bar.order=1,decreasing=TRUE, ...)
```

Arguments

`data`	output object of ea2 function (see examples)
`plot`	type of plot 1 = bar plot factor 1(default) 2 = bar plot factor 2 3 = bar plot interactions (option 1) 4 = bar plot interactions (option 2) 5 = bar plot interactions (option 3) 6 = bar plot interactions (option 4)
`s`	s=1 (defalt) plot standard deviation s=2 plot standard error of mean
`test`	Letters of the post-hoc test 1=Tukey 2=SNK 3=Duncan 4=t 5=Scott-Knott
`legend`	TRUE = plot p-value of F test FALSE = not plot p-value
`letters`	TRUE = plot letters FALSE = not plot letters
`family`	font of plot
`bg`	background color
`cex.names`	font size in names of treatments (x-axis)
`cex.text`	font size in letters and means
`cex.legend`	font size in legend
`bar.order`	order of bar or means 1 = order of treatments names 2 = order of the means (default)
`decreasing`	decreasing bar order (TRUE or FALSE)
`...`	more plot parameters

Value

Returns bar plots

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2, means.plot, box.plot

Examples

```
#data3: Kaps and Lamberson (2009): page 347
#Description:
##Latin square design for test four different treatments on hay intake of fattening steers

data(data3)

r<-ea1(data3, design=3)


#plot
means.plot(r, col=gray.colors(4))

# more graphical parameters
means.plot(r, col=c(2,7,3,5), bg="cornsilk", las=1, cex.names=2,
sub="treatments", family="sans");grid(10)

# plot = 2
means.plot(r, plot=2, col="dark green", bg="gray", las=1, cex.names=2,
sub="Treatments", family="Times", ylab="Hay intake")

# plot = 2 decreasing =FALSE
means.plot(r, plot=2, las=1, cex.names=2, col="red",lty=2,pch=20,cex=1.1,
sub="Treatments", family="Times", ylab="Hay intake", decreasing=FALSE, legend=FALSE);grid(10)

# plot=3
means.plot(r, plot=3, las=1, cex.names=2,
sub="Contrasts (Tukey 0.05)", family="Times", ylab="")

# plot=3  alpha=0.10
means.plot(ea1(data3, design=3), plot=3, las=2, cex.names=2,
sub="Contrasts (Tukey 0.10)", family="Times", ylab="", alpha=0.10, bg="cornsilk");grid(10)
```

---

p.plot *Plot p values of the contrasts*

Description

Plot p values of the contrasts

Usage

```
p.plot(data, ylab="", xlab="", col.lines="red", cex.axis=0.7,
cex=0.9 , col.text="dark green",family="Times", bg="white",...)
```

Arguments

`data`	output object of ea1 or ea2 function (see examples)
`ylab`	title of y-axis
`xlab`	title of x-axis
`col.lines`	colours of the lines
`cex.axis`	font size in axis
`cex`	size of points
`col.text`	colours in letters and means
`family`	font of plot
`bg`	background color
`...`	more plot parameters

Value

Plot p values of the contrasts

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2, box.plot, means.plot, means.plotfat, ic, ic.plot, m.plot

Examples

```
#data3: Kaps and Lamberson (2009): page 347
#Description:
##Latin square design for test four different treatments on hay intake of fattening steers

data(data3)

r<-ea1(data3, design=3)


#plot
contrasts=r[[3]]
contrasts
p.plot(contrasts)

#direct
p.plot(r[3])
```

```
# more graphical parameters
p.plot(contrasts, bg="cornsilk", cex=1.5,cex.axis=1.5,
main="P-values of the tukey contrasts",family="sans");grid(10)

data('data7')
r<-ea2(data7,4)
p.plot(r[[5]], bg="cornsilk");grid(10)

par(mfrow=c(1,2))
p.plot(r[[9]][1], xlab="treatment 1", cex=0.5, bg="cornsilk");grid(10)
p.plot(r[[9]][2], xlab="treatment 2", cex=0.5, bg="cornsilk");grid(10)
```

---

tab *Table of results in the ea1 function*

Description

Summary of results in ea1 function

Usage

```
tab(data, test=1)
```

Arguments

data	output object of ea1 function (see examples)
test	Letters of the post-hoc test 1=Tukey 2=SNK 3=Duncan 4=t 5=Scott-Knott

Value

Summary of results in ea1 function

Author(s)

Emmanuel Arnhold <emmanuelarnhold@yahoo.com.br>

References

KAPS, M. and LAMBERSON, W. R. Biostatistics for Animal Science: an introductory text. 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, UK, 2009. 504p.

See Also

ea1,ea2, box.plot, means.plot, means.plotfat, ic.plot, p.plot

Examples

```
#data3: Kaps and Lamberson (2009): page 347
#Description:
##Latin square design for test four different treatments on hay intake of fattening steers

data(data3)

r<-ea1(data3, design=3)

tab(r)

### multiple variables

t<-c('a','a','a','b','b','b','c','c','c')
r1<-c(10,12,12.8,4,6,8,14,15,16)
r2<-c(102,105,106,125,123,124,99,95,96)
r3<-c(560,589,590,658,678,629,369,389,378)


d<-data.frame(t,r1,r2,r3)

results=ea1(d, design=1, list=TRUE)

# scottknott test
tab(results,test=5)
```

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