Package 'StroupGLMM'

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Type Package

Title R Codes and Datasets for Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup

Version 0.1.0

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Description R Codes and Datasets for Stroup, W. W. (2012). Generalized Linear Mixed Models: Modern Concepts, Methods and Applications, CRC Press.

Depends R (>= 3.1)

Imports aod, broom, car, ggplot2, lme4, lmerTest, lsmeans, MASS, mutoss, nlme, pbkrtest, phia, stats, survey

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URL https://github.com/MYaseen208/StroupGLMM

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R topics documented:

DataExam2.B.2 2
DataExam2.B.3 3
DataExam2.B.4 4
DataExam2.B.7 5
DataSet3.1 6
DataSet3.2 7
DataSet3.3 8

DataSet4.1 . . . 9
DataSet5.1 . . . 10
DataSet5.2 . . . 11
Exam1.1 . . . 12
Exam1.2 . . . 16
Exam2.B.1 . . . 17
Exam2.B.2 . . . 18
Exam2.B.3 . . . 19
Exam2.B.4 . . . 21
Exam2.B.5 . . . 22
Exam2.B.6 . . . 24
Exam2.B.7 . . . 25
Exam3.2 . . . 27
Exam3.3 . . . 29
Exam3.5 . . . 32
Exam3.9 . . . 34
Exam4.1 . . . 37
Exam5.1 . . . 39
Exam5.2 . . . 41
Exam5.3 . . . 45
Table1.1 . . . 47
Table1.2 . . . 48

Index **49**

`DataExam2.B.2` *Data for Example 2.B.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup (p-54)*

Description

Exam2.B.2 is used to visualize the effect of glm model statement with binomial data with logit and probit links.

Usage

```
data(DataExam2.B.2)
```

Format

A `data.frame` with 11 rows and 3 variables.

Details

- x independent variable
- n bernouli trials(bernouli outcomes on each individual)
- y number of successes on each individual

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam2.B.2

Examples

```
data(DataExam2.B.2)
```

`DataExam2.B.3` *Data for Example 2.B.3 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup (p-55)*

Description

Exam2.B.3 is used to illustrate one way treatment design with Gaussian observations.

Usage

```
data(DataExam2.B.3)
```

Format

A `data.frame` with 6 rows and 2 variables.

Details

- trt treatments as factor with number 1 to 3
- y response variable

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam2.B.3

Examples

```
data(DataExam2.B.3)
```

DataExam2.B.4 *Data for Example 2.B.4 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup (p-54)*

Description

Exam2.B.4 is used to illustrate one way treatment design with Binomial observations.

Usage

```
data(DataExam2.B.4)
```

Format

A `data.frame` with 6 rows and 4 variables.

Details

- obs number of observations
- trt three treatments with class factor
- Nij number of bernouli trials on each individual
- y number of successes on each individual

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam2.B.4

Examples

```
data(DataExam2.B.4)
```

DataExam2.B.7 *Data for Example 2.B.7 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup (p-60)*

Description

Exam2.B.7 is related to multi batch regression data assuming different forms of linear models with factorial experiment.

Usage

```
data(DataExam2.B.7)
```

Format

A `data.frame` with 16 rows and 4 variables.

Details

- Rep number of replications
- a factor with two levels 1 and 2
- b factor with two levels 1 and 2
- y response variable

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam2.B.7

Examples

```
data(DataExam2.B.7)
```

DataSet3.1 *Data for Example 3.1 and Example 3.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup*

Description

DataSet3.1 is used for linear and generalized linear models

Usage

```
data(DataSet3.1)
```

Format

A `data.frame` with 20 rows and 5 variables.

Details

- trt two treatment 0 and 1
- rep unit of observation or observation ID
- Y is continuous & may be assumed Gaussian
- N is the number of obs
- F is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam3.2

Examples

```
data(DataSet3.1)
```

DataSet3.2 *DataSt3.2 for Example 3.3, Example 3.4, Example3.6, Example3.8 and Example 3.9 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup*

Description

DataSet3.2 Multi-Location, 4 Treatment Randomized Block

Usage

```
data(DataSet3.2)
```

Format

A `data.frame` with 32 rows and 10 variables.

Details

- trt two treatment 0 and 1
- loc four locations used as blocks
- Y is Gaussian response variable
- Nbin subjects at each Loc x Trt for binomial response
- S1 and S2 are two binomial response variables
- count1 and count 2 used later
- A and B are factors with level 0 and 1

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam3.3 Exam3.9

Examples

```
data(DataSet3.2)
```

DataSet3.3 *Data for Example3.7 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup*

Description

Exam1.2 is used to see types of model effects by plotting regression data

Usage

```
data(DataSet3.3)
```

Format

A `data.frame` with 36 rows and 6 variables.

Details

- X Each batch observed at several times:0,3,6,12,24,36,48 months
- Y continuous variable observed at each level of X
- Fav number of successes
- N isndependent bernoulli trials
- Batch Batches as 1, 2, 3, 4
- Count binomial response variable

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

Examples

```
data(DataSet3.3)
```

DataSet4.1 *Data for Example 4.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup*

Description

DataSet4.1 comes from Cochran and Cox (1957) Experimental Design

Usage

```
data(DataSet4.1)
```

Format

A `data.frame` with 60 rows and 3 variables.

Details

- blocks 15 blocks in an incomplete block desgin
- trt treatments representing incomplete block desgin
- y is continuous & may be assumed Gaussian

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.
2. Cochran, W. G., & Cox, G. M. (1957). *Experimental designs*.

See Also

Exam4.1

Examples

```
data(DataSet4.1)
```

DataSet5.1 *Data for Example 5.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup*

Description

DataSet5.1 is used for polynomial multiple regression

Usage

```
data(DataSet5.1)
```

Format

A `data.frame` with 14 rows and 3 variables.

Details

- X is predictor variable with level 0, 1, 2, 4, 8, 12, 16
- N is the number of independent bernoulli trials for a given observation
- F is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam5.1

Examples

```
data(DataSet5.1)
```

DataSet5.2 *Data for Example 5.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup*

Description

DataSet5.2 is used for three factor orthogonal main effects only design with sequential fitting of predictors

Usage

```
data(DataSet5.2)
```

Format

A `data.frame` with 9 rows and 4 variables.

Details

- a is predictor variable with level 0, 1
- b is predictor variable with level 0, 1
- c is predictor variable with level 0, 1
- y response variable

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam5.2

Examples

```
data(DataSet5.2)
```

Exam1.1 *Example1.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-5)*

Description

Exam1.1 is used for inspecting probability distribution and to define a plausible process through linear models and generalized linear models.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

Table1.1

Examples

```
#-------------------------------------------------------------
## Linear Model and results discussed in Article 1.2.1 after Table1.1
#-------------------------------------------------------------
data(Table1.1)
Exam1.1.lm1 <-
  lm(
      formula     =  y/Nx~x
    , data        =  Table1.1
    # , subset
    # , weights
    # , na.action
    , method      =  "qr"
    , model       =  TRUE
    , x           =  FALSE
    , y           =  FALSE
    , qr          =  TRUE
    , singular.ok =  TRUE
    , contrasts   =  NULL
    # , offset
    # , ...
  )
summary(Exam1.1.lm1 )

#-------------------------------------------------------------
```

```
## GLM fitting with logit link (family=binomial)
#-------------------------------------------------------------
Exam1.1.glm1 <-
  glm(
      formula     =  y/Nx~x
    , family      =  binomial(link = "logit")
    , data        =  Table1.1
    , weights     =  NULL
    # , subset
    # , na.action
    , start       =  NULL
    # , etastart
    # , mustart
    # , offset
    # , control     =  list(...)
    # , model       =  TRUE
    , method      =  "glm.fit"
    , x           =  FALSE
    , y           =  TRUE
    , contrasts   =  NULL
    # , ...
  )
## this glm() function gives warning message of non-integer success
summary(Exam1.1.glm1)

#-------------------------------------------------------------
## GLM fitting with logit link (family=Quasibinomial)
#-------------------------------------------------------------
Exam1.1.glm2 <-
  glm(
      formula   =  y/Nx~x
    , family    =  quasibinomial(link = "logit")
    , data      =  Table1.1
    , weights   =  NULL
    # , subset
    # , na.action
    , start     =  NULL
    # , etastart
    # , mustart
    # , offset
    # , control   =  list(...)
    # , model     =  TRUE
    , method    =  "glm.fit"
    , x         =  FALSE
    , y         =  TRUE
    , contrasts =  NULL
    # , ...
  )
## problem of "warning message of non-integer success" is overome by using quasibinomial family
summary(Exam1.1.glm2)

#-------------------------------------------------------------
## GLM fitting with survey package(produces same result as using quasi binomial family in glm)
```

```
#-------------------------------------------------------------
library(survey)
design   <-
  svydesign(
      ids          =  ~1
    , probs        =  NULL
    , strata       =  NULL
    , variables    =  NULL
    , fpc          =  NULL
    , data         =  Table1.1
    # , nest         =  FALSE
    # , check.strata =  !nest
    , weights      =  NULL
    , pps          =  FALSE
    # , ...
  )

Exam1.1.svyglm  <-
  svyglm(
      formula  =  y/Nx~x
    , design   =  design
    # , ...
    , family   =  quasibinomial(link="logit")
  )
# summary(Exam1.1.svyglm)

#-------------------------------------------------------------
## Figure 1.1
#-------------------------------------------------------------
Newdata     <-
  data.frame(
    Table1.1
    , LM       =  Exam1.1.lm1$fitted.values
    , GLM      =  Exam1.1.glm1$fitted.values
    , QB       =  Exam1.1.glm2$fitted.values
    , SM       =  Exam1.1.svyglm$fitted.values
  )
#-------------------------------------------------------------
## One Method to plot  Figure1.1
#-------------------------------------------------------------
library(ggplot2)

Figure1.1   <-
  ggplot(
      data     = Newdata
    , mapping  = aes(x=x,y=y/Nx)
  )     +
  geom_point (
    mapping  = aes(colour="black")
  )  +
  geom_point (
    data     = Newdata
    , mapping  = aes(x=x,y=LM,colour="blue"),shape=2
```

```
  )  +
  geom_line(
    data     = Newdata
    , mapping  = aes(x=x,y=LM,colour="blue")
  )   +
  geom_point (
    data     = Newdata
    , mapping  = aes(x=x,y=GLM,colour="red"),shape=3
  ) +
  geom_smooth (
    data     = Newdata
    , mapping  = aes(x=x,y=GLM,colour="red")
    , stat     = "smooth"
  ) +
  theme_bw()    +
  scale_colour_manual (
    values=c("black","blue","red"),
    labels=c("observed","LM","GLM")
  )  +
  guides (
    colour   = guide_legend(title="Plot")
  ) +
  labs (
    title     = "Linear Model vs Logistic Model"
  ) +
  labs (
    y         = "p"
  )
print(Figure1.1)

 #------------------------------------------------------------
## Another way to plot Figure 1.1
#------------------------------------------------------------
newdata   <-
  data.frame(
    P     =  c(
                Table1.1$y/Table1.1$Nx
              , Exam1.1.lm1$fitted.values
              , Exam1.1.glm1$fitted.values
               )
    , X     =  rep(Table1.1$x, 3)
    , group =  rep(c('Obs','LM','GLM'), each = length(Table1.1$x))
  )

Figure1.1      <-
  ggplot(
      data    = newdata
    , mapping = aes(x = X , y = P)
  )    +
  geom_point(
    mapping = aes(x = X , y = P, colour = group , shape=group)
  ) +
  geom_smooth(
```

```
    data    = subset(x = newdata, group == "LM")
    , mapping = aes(x=X,y=P)
    , col     = "green"
  ) +
  geom_smooth(
    data    = subset(x = newdata, group=="GLM")
    , mapping = aes(x = X , y = P)
    , col     = "red"
  ) +
  theme_bw() +
  labs(
    title   = "Linear Model vs Logistic Model"
  )
print(Figure1.1)

#-------------------------------------------------------------
## Correlation among p and fitted values using Gaussian link
#-------------------------------------------------------------
(lmCor <-
  cor(
    Table1.1$y/Table1.1$Nx,Exam1.1.lm1$fitted.values)
)
#-------------------------------------------------------------
## Correlation among p and fitted values using quasi binomial link
#-------------------------------------------------------------
(glmCor  <-
  cor(
    Table1.1$y/Table1.1$Nx,Exam1.1.glm1$fitted.values)
)
```

Exam1.2 *Example1.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-9)*

Description

Exam1.2 is used to see types of model effects by plotting regression data

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

Table1.2

Examples

```
#-------------------------------------------------------------
## Plot of multi-batch regression data discussed in Article 1.3
#-------------------------------------------------------------
data(Table1.1)
Table1.2$Batch <- factor(x  = Table1.2$Batch)
library(ggplot2)
Plot  <-
 ggplot(
   data    = Table1.2
   , mapping = aes(y = Y, x =X,colour=Batch,shape=Batch)
 )      +
 geom_point() +
 geom_smooth(
   method  = "lm"
   , fill    =  NA
 ) +
 labs(
   title   = "Plot of Multi Batch Regression data"
 )        +
 theme_bw()
```

Exam2.B.1 *Example 2.B.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-53)*

Description

Exam2.B.1 is used to visualize the effect of lm model statement with Gaussian data and their design matrix

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

Table1.1

Examples

```
#-------------------------------------------------------------------------------
## Linear Model  discussed in Example 2.B.1 using simple regression data of Table1.1
#-------------------------------------------------------------------------------
data(Table1.1)
Exam2.B.1.lm1 <-
  lm(
      formula     = y~x
    , data        = Table1.1
    #  , subset
    #  , weights
    #  , na.action
    , method      = "qr"
    , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
    #  , offset
    #  , ...
  )
summary(Exam2.B.1.lm1)
DesignMatrix.lm1 <-
  model.matrix (
    object = Exam2.B.1.lm1
  )
DesignMatrix.lm1
```

`Exam2.B.2` *Example 2.B.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-54)*

Description

Exam2.B.2 is used to visualize the effect of glm model statement with binomial data with logit and probit links.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataExam2.B.2

Examples

```
#-------------------------------------------------------------------------------
## probitit Model  discussed in Example 2.B.2 using DataExam2.B.2
## Default link is logit
## using fmaily=binomial gives warning message of no-integer successes
#-------------------------------------------------------------------------------
data(DataExam2.B.2)
Exam2.B.2glm <-
  glm(
      formula    =  y/n~x
    , family     =  quasibinomial(link = "probit")
    , data       =  DataExam2.B.2
    , weights    =  NULL
 #  , subset
 #  , na.action
    , start      =  NULL
 #  , etastart
 #  , mustart
 #  , offset
 #  , control    =  list(...)
 #  , model      =  TRUE
    , method     =  "glm.fit"
 #  , x          =  FALSE
 #  , y          =  TRUE
    , contrasts  =  NULL
    #  , ...
  )
summary(Exam2.B.2glm)
```

Exam2.B.3 *Example 2.B.3 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-55)*

Description

Exam2.B.3 is used to illustrate one way treatment design with Gaussian observations.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataExam2.B.3

Examples

```
#-------------------------------------------------------------------------------
## Means Model  discussed in Example 2.B.3 using DataExam2.B.3
#-------------------------------------------------------------------------------
Exam2.B.3.lm1 <-
  lm(
      formula     = y~trt
    , data        = DataExam2.B.3
    #  , subset
    #  , weights
    #  , na.action
    , method      = "qr"
    , model       = TRUE
 #  , x           = FALSE
 #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
    #  , offset
    #  , ...
  )
summary(Exam2.B.3.lm1)
#-------------------------------------------------------------------------------
## Effectss Model  discussed in Example 2.B.3 using DataExam2.B.3
#-------------------------------------------------------------------------------
Exam2.B.3.lm2 <-
  lm(
      formula     = y~0+trt
    , data        = DataExam2.B.3
    #  , subset
    #  , weights
    #  , na.action
    , method      = "qr"
    , model       = TRUE
 #  , x           = FALSE
 #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
    #  , offset
    #  , ...
  )
summary(Exam2.B.3.lm2)
```

`Exam2.B.4` *Example 2.B.4 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-56)*

Description

Exam2.B.4 is used to illustrate one way treatment design with Binomial observations.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

`DataExam2.B.4`

Examples

```
#-------------------------------------------------------------------------------
## logit Model  discussed in Example 2.B.2 using DataExam2.B.4
## Default link is logit
## using fmaily=binomial gives warning message of no-integer successes
#-------------------------------------------------------------------------------
data(DataExam2.B.4)
DataExam2.B.4$trt <- factor(x =  DataExam2.B.4$trt)
Exam2.B.4glm <-
  glm(
         formula    =  Yij/Nij~trt
       , family     =  quasibinomial(link = "probit")
       , data       =  DataExam2.B.4
       , weights    =  NULL
    #  , subset
    #  , na.action
       , start      =  NULL
    #  , etastart
    #  , mustart
    #  , offset
    #  , control    =  list(...)
    #  , model      =  TRUE
       , method     =  "glm.fit"
    #  , x          =  FALSE
    #  , y          =  TRUE
       , contrasts  =  NULL
```

```
    #  , ...
  )
summary(Exam2.B.4glm)
```

Exam2.B.5 *Example 2.B.5 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-57)*

Description

Exam2.B.5 is related to multi batch regression data assuming different forms of linear models.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

Table1.2

Examples

```
#-------------------------------------------------------------------------------
## Nested Model with no intercept
#-------------------------------------------------------------------------------
data(Table1.2)
Table1.2$Batch <- factor(x = Table1.2$Batch)
Exam2.B.5.lm1 <-
  lm(
        formula     = Y~0+Batch+ Batch/X
      , data        = Table1.2
    #  , subset
    #  , weights
    #  , na.action
      , method      = "qr"
      , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
      , qr          = TRUE
      , singular.ok = TRUE
      , contrasts   = NULL
    #  , offset
    #  , ...
```

```
  )
DesignMatrix.lm1 <- model.matrix (object = Exam2.B.5.lm1)
DesignMatrix.lm1
#-------------------------------------------------------------------------------------
## Interaction Model with intercept
#-------------------------------------------------------------------------------------
Exam2.B.5.lm2 <-
  lm(
         formula     = Y~Batch +X+ Batch*X
       , data        = Table1.2
    #  , subset
    #  , weights
    #  , na.action
       , method      = "qr"
       , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
       , qr          = TRUE
       , singular.ok = TRUE
       , contrasts   = NULL
    #  , offset
    #  , ...
  )
DesignMatrix.lm2 <-   model.matrix (object = Exam2.B.5.lm2)
DesignMatrix.lm2
#-------------------------------------------------------------------------------------
## Interaction Model with no intercept
#-------------------------------------------------------------------------------------
Exam2.B.5.lm3 <-
  lm(
         formula     = Y~0 + Batch + Batch*X
       , data        = Table1.2
    #  , subset
    #  , weights
    #  , na.action
       , method      = "qr"
       , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
       , qr          = TRUE
       , singular.ok = TRUE
       , contrasts   = NULL
    #  , offset
    #  , ...
  )
DesignMatrix.lm3 <-   model.matrix(object = Exam2.B.5.lm3)
#-------------------------------------------------------------------------------------
## Interaction Model with intercept  but omitting X term as main effect
#-------------------------------------------------------------------------------------
Exam2.B.5.lm4 <-
  lm(
         formula     = Y~Batch + Batch*X
       , data        = Table1.2
```

```
    #  , subset
    #  , weights
    #  , na.action
       , method      = "qr"
       , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
       , qr          = TRUE
       , singular.ok = TRUE
       , contrasts   = NULL
    #  , offset
    #  , ...
  )
DesignMatrix.lm4 <-   model.matrix(object = Exam2.B.5.lm4)
DesignMatrix.lm4
```

`Exam2.B.6` *Example 2.B.6 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-58)*

Description

Exam2.B.6 is related to multi batch regression data assuming different forms of linear models keeping batch effect random.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

`Table1.2`

Examples

```
#-------------------------------------------------------------------------------
## Nested Model with no intercept
#-------------------------------------------------------------------------------
data(Table1.2)
library(nlme)
Table1.2$Batch <- factor(x = Table1.2$Batch)
Exam2.B.6fm1 <-
  lme(
```

```
    fixed       = Y~X
  , data        = Table1.2
  , random      = list(Batch = pdDiag(~1), X = pdDiag(~1))
  , correlation = NULL
  , weights     = NULL
# , subset
  , method      = "REML" #c("REML", "ML")
  , na.action   = na.fail
# , control     = list()
  , contrasts   = NULL
  , keep.data   = TRUE
)
```

`Exam2.B.7` *Example 2.B.7 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-60)*

Description

Exam2.B.7 is related to multi batch regression data assuming different forms of linear models with factorial experiment.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataExam2.B.7

Examples

```
#-------------------------------------------------------------------------------
## Classical main effects and Interaction Model
#-------------------------------------------------------------------------------
data(DataExam2.B.7)
DataExam2.B.7$a <- factor(x = DataExam2.B.7$a)
DataExam2.B.7$b <- factor(x = DataExam2.B.7$b)
Exam2.B.7.lm1 <-
  lm(
       formula     = y~ a + b + a*b
     , data        = DataExam2.B.7
   #  , subset
```

```
    #  , weights
    #  , na.action
       , method      = "qr"
       , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
       , qr          = TRUE
       , singular.ok = TRUE
       , contrasts   = NULL
    #  , offset
    #  , ...
  )
#-------------------------------------------------------------------------------
## One way treatment effects model
#-------------------------------------------------------------------------------
DesignMatrix.lm1 <- model.matrix (object = Exam2.B.7.lm1)
DesignMatrix2.B.7.2 <- DesignMatrix.lm1[,!colnames(DesignMatrix.lm1) %in% c("a2","b")]
lmfit2 <-
  lm.fit(
      x           = DesignMatrix2.B.7.2
    , y           = DataExam2.B.7$y
    , offset      = NULL
    , method      = "qr"
    , tol         = 1e-07
    , singular.ok = TRUE
    # , ...
  )
Coefficientslmfit2 <- coef( object = lmfit2)
#-------------------------------------------------------------------------------
## One way treatment effects model without intercept
#-------------------------------------------------------------------------------
DesignMatrix2.B.7.3    <-
 as.matrix(DesignMatrix.lm1[,!colnames(DesignMatrix.lm1) %in% c("(Intercept)","a2","b")])

lmfit3 <-
  lm.fit(
      x           = DesignMatrix2.B.7.3
    , y           = DataExam2.B.7$y
    , offset      = NULL
    , method      = "qr"
    , tol         = 1e-07
    , singular.ok = TRUE
    # , ...
  )
Coefficientslmfit3 <- coef( object = lmfit3)

#-------------------------------------------------------------------------------
## Nested Model (both models give the same result)
#-------------------------------------------------------------------------------
Exam2.B.7.lm4 <-
  lm(
         formula     = y~ a + a/b
       , data        = DataExam2.B.7
```

```
    #  , subset
    #  , weights
    #  , na.action
       , method      = "qr"
       , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
       , qr          = TRUE
       , singular.ok = TRUE
       , contrasts   = NULL
    #  , offset
    #  , ...
  )
summary(Exam2.B.7.lm4)

Exam2.B.7.lm4 <-
  lm(
        formula     = y~ a + a*b
      , data        = DataExam2.B.7
    #  , subset
    #  , weights
    #  , na.action
       , method      = "qr"
       , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
       , qr          = TRUE
       , singular.ok = TRUE
       , contrasts   = NULL
    #  , offset
    #  , ...
  )
summary(Exam2.B.7.lm4)
```

`Exam3.2` *Example 3.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-73)*

Description

Exam3.2 used binomial data, two treatment samples

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet3.1

Examples

```
#-------------------------------------------------------------
## Linear Model and results discussed in Article 1.2.1 after Table1.1
#-------------------------------------------------------------
data(DataSet3.1)
DataSet3.1$trt <- factor(x =  DataSet3.1$trt)
Exam3.2.glm <-
  glm(
         formula    =  F/N~trt
       , family     =  quasibinomial(link = "logit")
       , data       =  DataSet3.1
       , weights    =  NULL
    #  , subset
    #  , na.action
       , start      =  NULL
    #  , etastart
    #  , mustart
    #  , offset
    #  , control    =  list(...)
    #  , model      =  TRUE
       , method     =  "glm.fit"
    #  , x          =  FALSE
    #  , y          =  TRUE
       , contrasts  =  NULL
    #  , ...
  )
summary(Exam3.2.glm)

#-------------------------------------------------------------
## Individula least squares treatment means
#-------------------------------------------------------------
library(lsmeans)
(Lsm3.2    <-
  lsmeans::lsmeans(
    object  = Exam3.2.glm
    , specs   = "trt"
    # , ...
  )
)
OddsRatioMean3.2 <-  1/(1 + exp(-summary(Lsm3.2)[c("lsmean")] ) )
#-----------------------------------------------------
## Over all mean
#-----------------------------------------------------
library(phia)
list3.2<-   list(trt=c("0" = 0.5,"1" = 0.5 ))
(Test3.2 <-
  testFactors(
      model  =  Exam3.2.glm
```

```
    , levels =  list3.2 )
)
#-------------------------------------------------
## Pairwise treatment means estimate
#-------------------------------------------------
contrast(object = Lsm3.2 , method = "pairwise")
#-------------------------------------------------
## Repairwise treatment means estimate
#-------------------------------------------------
## contrast( object = Lsm3.2 , method = "repairwise")
```

Exam3.3 *Example 3.3 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-77)*

Description

Exam3.3 use RCBD data with fixed location effect and different forms of estimable functions are shown in this example.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet3.2

Examples

```
#-------------------------------------------------------------------------------
## linear model for Gaussian data
#-------------------------------------------------------------------------------
data(DataSet3.2)
DataSet3.2$trt <- factor(x = DataSet3.2$trt, level = c(3,0,1,2))
DataSet3.2$loc <- factor(x = DataSet3.2$loc, level = c(8, 1, 2, 3, 4, 5, 6, 7))
Exam3.3.lm1 <-
  lm(
        formula     = Y~ trt+loc
      , data        = DataSet3.2
    #  , subset
    #  , weights
    #  , na.action
```

```
       , method      = "qr"
       , model       = TRUE
    #  , x           = FALSE
    #  , y           = FALSE
       , qr          = TRUE
       , singular.ok = TRUE
       , contrasts   = NULL
    #  , offset
    #  , ...
  )
summary( Exam3.3.lm1 )
#-------------------------------------------------------------
## Individula least squares treatment means
#-------------------------------------------------------------
library(lsmeans)
(Lsm3.3    <-
  lsmeans::lsmeans(
      object  = Exam3.3.lm1
    , specs   = "trt"
    # , ...
  )
)
#-----------------------------------------------------
## Pairwise treatment means estimate
#-----------------------------------------------------
contrast( object = Lsm3.3 , method = "pairwise")
#-----------------------------------------------------
## Repairwise treatment means estimate
#-----------------------------------------------------
## contrast( object = Lsm3.3 , method = "repairwise")
#-------------------------------------------------------
## LSM Trt0 (This term is used in Walter Stroups' book)
#-------------------------------------------------------
library(phia)
list3.3.1 <- list(trt=c("0" = 1 ) )
Test3.3.1 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels =  list3.3.1)
  )
#-------------------------------------------------------
## LSM Trt0 alt(This term is used in Walter Stroups' book)
#-------------------------------------------------------
list3.3.2 <-
  list(trt=c("0" = 1 )
       , loc=c("1" = 0,"2" = 0,"3" = 0,"4" = 0,"5" = 0,"6" = 0,"7" = 0)
  )
Test3.3.2 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels =  list3.3.2)
  )
#-------------------------------------------------------
```

```
##  Trt0 Vs Trt1
#-------------------------------------------------------
list3.3.3 <- list(trt=c("0" = 1,"1" = -1))
Test3.3.3 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels =  list3.3.3)
  )
#-------------------------------------------------------
##  average Trt0+1
#-------------------------------------------------------
list3.3.4 <- list(trt=c("0" = 0.5 , "1" = 0.5))
Test3.3.4 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels =  list3.3.4)
  )
#-------------------------------------------------------
##  average Trt0+2+3
#-------------------------------------------------------
list3.3.5 <- list(trt=c("0" = 0.33333,"2" = 0.33333,"3" = 0.33333))
Test3.3.5 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels = list3.3.5)
  )
#-------------------------------------------------------
##  Trt 2 Vs 3 difference
#-------------------------------------------------------
list3.3.6 <- list(trt=c("2" = 1,"3" = -1))
Test3.3.6 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels = list3.3.6)
  )
#-------------------------------------------------------
##  Trt 1 Vs 2 difference
#-------------------------------------------------------
list3.3.7 <- list(trt=c("1" = 1,"2" = -1))
Test3.3.7 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels = list3.3.7)
  )
#-------------------------------------------------------
##  Trt 1 Vs 3 difference
#-------------------------------------------------------
list3.3.8 <- list(trt=c("1" = 1,"3" = -1))
Test3.3.8 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels = list3.3.8)
  )
```

```
#-------------------------------------------------------
##  Average trt0+1  vs Average Trt2+3
#-------------------------------------------------------
list3.3.9 <-  list(trt=c("0" = 0.5,"1" = 0.5,"2" = -0.5,"3" = -0.5))
Test3.3.9 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels = list3.3.9)
  )
#-------------------------------------------------------
##  Trt1  vs Average Trt0+1+2
#-------------------------------------------------------
list3.3.10 <- list(trt=c("0" = 0.33333,"1" = -1,"2" = 0.33333,"3" = 0.33333))
Test3.3.10 <-
summary(testFactors(
    model  =  Exam3.3.lm1
  , levels = list3.3.10)
  )
#-------------------------------------------------------
## Sidak Multiplicity adjustment for p-values
#-------------------------------------------------------
library(mutoss)
PValues3.3 <-
  c(
    Test3.3.3[[7]][1, 4]
  , Test3.3.6[[7]][1, 4]
  , Test3.3.7[[7]][1, 4]
  , Test3.3.8[[7]][1, 4]
  , Test3.3.9[[7]][1, 4]
  , Test3.3.10[[7]][1, 4]
   )
 AdjPValues3.3 <- sidak(PValues3.3)
```

`Exam3.5` *Example 3.5 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-85)*

Description

Exam3.5 fixed location, factorial treatment structure, Gaussian response

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet3.2

Examples

```
data(DataSet3.2)
DataSet3.2$A <- factor(x = DataSet3.2$A)
DataSet3.2$B <- factor(x = DataSet3.2$B)
DataSet3.2$loc <- factor(x = DataSet3.2$loc, level = c(8, 1, 2, 3, 4, 5, 6, 7))
Exam3.5.lm <-
  lm(
        formula     =  Y~ A + B +loc
      , data        =  DataSet3.2
    #  , subset
    #  , weights
    #  , na.action
      , method      =  "qr"
      , model       =  TRUE
    #  , x           =  FALSE
    #  , y           =  FALSE
      , qr          =  TRUE
      , singular.ok =  TRUE
      , contrasts   =  NULL
    #  , offset
    #  , ...
  )

##---a0 marginal mean
list3.5.a0 <- list(B = c("0" = 1,"1" = 0) )
library(phia)
Test3.5.a0 <-
  summary(testFactors(
      model  =  Exam3.5.lm
    , levels =  list3.5.a0)
    )

##---b0 marginal mean
list3.5.b0 <- list(B = c("0" = 1,"1" = 0) )
Test3.5.b0 <-
summary(testFactors(
    model  =  Exam3.5.lm
  , levels =  list3.5.b0)
  )

##---Simple effect of A on B0
Test3.5.AB0 <-
  summary(testInteractions(
      model  =  Exam3.5.lm
    , custom =  list3.5.b0
    , across =  "B")
    )
```

```
##---Simple effect of B on A0
Test3.5.BA0 <-
  summary(testInteractions(
      model  =  Exam3.5.lm
    , custom =  list3.5.a0
    , across =  "A")
    )

##---Simple Effect of A over B
(SimpleEffect3.5.AB <-
  summary(testInteractions(
      model  =  Exam3.5.lm
    , fixed  =   "A"
    , across =  "B")
    )
    )

##---Simple Effect of B over A
(SimpleEffect3.5.BA <-
  summary(testInteractions(
      model  =  Exam3.5.lm
    , fixed  =   "B"
    , across =  "A")
    )
)
#-------------------------------------------------------------
## Individula least squares treatment means
#-------------------------------------------------------------
(Lsm3.5 <-
  lsmeans::lsmeans(
      object  = Exam3.5.lm
    , specs   = ~A*B
    # , ...
  )
)
```

`Exam3.9` *Example 3.9 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-118)*

Description

Exam3.9 used to differentiate conditional and marginal binomial models with and without interaction for S2 variable.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet3.2

Examples

```
#-------------------------------------------------------------------------------
## Binomial conditional GLMM without interaction, logit link
#-------------------------------------------------------------------------------
library(MASS)
DataSet3.2$trt <- factor( x  =  DataSet3.2$trt )
DataSet3.2$loc <- factor( x  =  DataSet3.2$loc )
Exam3.9.fm1   <-
  glmmPQL(
      fixed    =  S2/Nbin~trt
    , random   = ~1|loc
    , family   =  quasibinomial(link = "logit")
    , data     =  DataSet3.2
  # , weights
  # , control
    , niter    = 10
    , verbose  = TRUE
    # , ...
  )
summary(Exam3.9.fm1)

#-------------------------------------------------------------
##  treatment means
#-------------------------------------------------------------
library(lsmeans)
(Lsm3.9fm1   <-
  lsmeans::lsmeans(
      object  = Exam3.9.fm1
    , specs   = "trt"
    , link=TRUE
    # , ...
  )
)
##--- Normal Approximation
library(nlme)
Exam3.9fm2 <-
  lme(
      fixed       = S2/Nbin~trt
    , data        = DataSet3.2
    , random      = ~1|loc
    , weights     = NULL
  # , subset
    , method      = "REML" #c("REML", "ML")
```

```
    , na.action   = na.fail
  # , control     = list()
    , contrasts   = NULL
    , keep.data   = TRUE
  )
(Lsm3.9fm2    <-
  lsmeans::lsmeans(
      object  = Exam3.9fm2
    , specs   = "trt"
    # , ...
  )
)

##---Binomial GLMM with interaction
Exam3.9fm3   <-
  glmmPQL(
      fixed       =  S2/Nbin~trt
    , random      = ~1|trt/loc
    , family      =  quasibinomial(link = "logit")
    , data        =  DataSet3.2
  # , weights
  # , control
    , niter = 10
    , verbose = TRUE
    # , ...
  )
summary(Exam3.9fm3)
(Lsm3.9fm3    <-
  lsmeans::lsmeans(
      object  = Exam3.9fm3
    , specs   = "trt"
  # , ...
  )
)

##---Binomial Marginal GLMM(assuming compound symmetry)
Exam3.9fm4   <-
  glmmPQL(
      fixed       =  S2/Nbin~trt
    , random      = ~1|loc
    , family      =  quasibinomial(link = "logit")
    , data        =  DataSet3.2
    , correlation =  corCompSymm(form=~1|loc)
  # , weights
  # , control
    , niter       = 10
    , verbose     = TRUE
  # , ...
  )
summary(Exam3.9fm4)
(Lsm3.9fm4  <-
  lsmeans::lsmeans(
      object  = Exam3.9fm4
```

```
    , specs   = "trt"
    # , ...
  )
)
```

Exam4.1 *Example 4.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-138)*

Description

Exam4.1 REML vs ML criterion is used keeping block effects random

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet4.1

Examples

```
DataSet4.1$trt   <- factor(x =  DataSet4.1$trt)
DataSet4.1$block <- factor(x =  DataSet4.1$block)

##---REML estimates on page 138(article 4.4.3.3)
library(lme4)
Exam4.1REML  <-
  lmer(
      formula     = y~ trt +( 1|block )
    , data        = DataSet4.1
    , REML        = TRUE
#   , control     = lmerControl()
    , start       = NULL
#   , verbose     = 0L
#   , subset
#   , weights
#   , na.action
#   , offset
    , contrasts   = NULL
    , devFunOnly  = FALSE
```

```
#  , ...
  )

VarCompREML4.1  <-
  VarCorr(x     =   Exam4.1REML
          # , sigma = 1
          # , ...
  )
print(VarCompREML4.1, comp=c("Variance"))

##---ML estimates on page 138(article 4.4.3.3)
Exam4.1ML  <-
  lmer(
        formula     = y ~ trt + (1|block)
       , data       = DataSet4.1
       , REML       = FALSE
   #  , control     = lmerControl()
       , start      = NULL
   #  , verbose     = 0L
   #  , subset
   #  , weights
   #  , na.action
   #  , offset
       , contrasts   = NULL
       , devFunOnly  = FALSE
   #  , ...
  )
VarCompML4.1  <-
  VarCorr(x     =    Exam4.1ML
          # , sigma = 1
          # , ...
  )
print(VarCompML4.1,comp=c("Variance"))

Exam4.1.lm <-
  lm(
      formula     = y~ trt + block
    , data        = DataSet4.1
 #  , subset
 #  , weights
 #  , na.action
    , method      = "qr"
    , model       = TRUE
 #  , x           = FALSE
 #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
 #  , offset
 #  , ...
  )
summary(anova(object = Exam4.1.lm))
```

Exam5.1 *Example 5.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-163)*

Description

Exam5.1 is used to show polynomial multiple regression with binomial response

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet5.1

Examples

```
##---Sequential Fit of the logit Model
Exam5.1.glm.1 <-
  glm(
      formula    =  F/N~ X
    , family     =  quasibinomial(link = "logit")
    , data       =  DataSet5.1
    , weights    =  NULL
 #  , subset
 #  , na.action
    , start      =  NULL
 #  , etastart
 #  , mustart
 #  , offset
 #  , control    =  list(...)
 #  , model      =  TRUE
    , method     =  "glm.fit"
 #  , x          =  FALSE
 #  , y          =  TRUE
    , contrasts  =  NULL
 #  , ...
  )
summary(Exam5.1.glm.1)

## confint.default()   produce Wald Confidence interval as SAS produces
```

```
##---Likelihood Ratio test for Model 1
(LRExam5.1.glm.1  <-
  anova(
      object =  Exam5.1.glm.1
    , test   = "Chisq")
)

library(aod)
WaldExam5.1.glm.1 <-
  wald.test(
      Sigma   = vcov(object=Exam5.1.glm.1)
    , b       = coef(object=Exam5.1.glm.1)
    , Terms   = 2
    , L       = NULL
    , H0      = NULL
    , df      = NULL
    , verbose = FALSE
  )

##---Sequential Fit of the logit Model quadratic terms involved
Exam5.1.glm.2 <-
  glm(
      formula    =  F/N~ X + I(X^2)
    , family     =  quasibinomial(link = "logit")
    , data       =  DataSet5.1
    , weights    =  NULL
 #  , subset
 #  , na.action
    , start      =  NULL
 #  , etastart
 #  , mustart
 #  , offset
 #  , control    =  list(...)
 #  , model      =  TRUE
    , method     =  "glm.fit"
 #  , x          =  FALSE
 #  , y          =  TRUE
    , contrasts  =  NULL
 #  , ...
  )
summary( Exam5.1.glm.2 )

##---Likelihood Ratio test for Model Exam5.1.glm.2
(LRExam5.1.glm.2   <-
  anova(
      object =  Exam5.1.glm.2
    , test   = "Chisq")
)

WaldExam5.1.glm.2 <-
  wald.test(
      Sigma   = vcov(object=Exam5.1.glm.2)
    , b       = coef(object=Exam5.1.glm.2)
```

```
    , Terms   = 3
    , L       = NULL
    , H0      = NULL
    , df      = NULL
    , verbose = FALSE
  )

##---Sequential Fit of the logit Model 5th power terms involved
Exam5.1.glm.3 <-
  glm(
      formula    =  F/N~ X + I(X^2) + I(X^3) + I(X^4) + I(X^5)
    , family     =  quasibinomial(link = "logit")
    , data       =  DataSet5.1
    , weights    =  NULL
 #  , subset
 #  , na.action
    , start      =  NULL
 #  , etastart
 #  , mustart
 #  , offset
 #  , control    =  list(...)
 #  , model      =  TRUE
    , method     =  "glm.fit"
 #  , x          =  FALSE
 #  , y          =  TRUE
    , contrasts  =  NULL
 #  , ...
  )
summary(Exam5.1.glm.3)

## confint.default()   produce Wald Confidence interval as SAS produces
##---Likelihood Ratio test for Model 1
(LRExam5.1.glm.3   <-
  anova(
      object =  Exam5.1.glm.3
    , test   = "Chisq")
)

WaldExam5.1.glm.3 <-
  wald.test(
      Sigma   = vcov(object=Exam5.1.glm.3)
    , b       = coef(object=Exam5.1.glm.3)
    , Terms   = 6
    , L       = NULL
    , H0      = NULL
    , df      = NULL
    , verbose = FALSE
  )
```

Exam5.2 *Example 5.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-164)*

Description

Exam5.2 three factor main effects only design

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet5.2

Examples

```
DataSet5.2$a <- factor( x = DataSet5.2$a)
DataSet5.2$b <- factor( x = DataSet5.2$b)
DataSet5.2$c <- factor(x  = DataSet5.2$c)
##---first adding factor a in model
Exam5.2.lm1 <-
  lm(
      formula     = y~ a
    , data        = DataSet5.2
 #  , subset
 #  , weights
 #  , na.action
    , method      = "qr"
    , model       = TRUE
 #  , x           = FALSE
 #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
 #  , offset
 #  , ...
  )
summary( Exam5.2.lm1 )

library(lsmeans)
##---A first
( Lsm5.2lm1    <-
```

```
  lsmeans::lsmeans(
     object  = Exam5.2.lm1
    , specs   = "a"
    # , ...
  )
)
## lsmeans::contrast(object = Lsm5.2lm1 , method = "pairwise")
Anovalm1  <-   anova(object   = Exam5.2.lm1)
Anovalm1

##---then adding factor b in model
Exam5.2.lm2 <-
  lm(
      formula     = y~ a + b
    , data        = DataSet5.2
 #  , subset
 #  , weights
 #  , na.action
    , method      = "qr"
    , model       = TRUE
 #  , x           = FALSE
 #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
 #  , offset
 #  , ...
  )
summary( Exam5.2.lm1 )
(Lsm5.2lm2    <-
  lsmeans::lsmeans(
      object  = Exam5.2.lm2
    , specs   = "b"
    # , ...
  )
)
## lsmeans::contrast(object = Lsm5.2lm2, method = "pairwise")
Anovalm2  <-   anova(object   = Exam5.2.lm2)
Anovalm2

##---then adding factor c in model
Exam5.2.lm3 <-
  lm(
      formula     = y~ a + b + c
    , data        = DataSet5.2
#   , subset
#   , weights
#   , na.action
    , method      = "qr"
    , model       = TRUE
#   , x           = FALSE
#   , y           = FALSE
    , qr          = TRUE
```

```
    , singular.ok = TRUE
    , contrasts   = NULL
#   , offset
#   , ...
  )
summary( Exam5.2.lm3 )
(Lsm5.2lm3    <-
  lsmeans::lsmeans(
      object  = Exam5.2.lm3
    , specs   = "c"
    # , ...
  )
)
## lsmeans::contrast(object = Lsm5.2lm3, method = "pairwise")
Anovalm3  <-  anova(object   = Exam5.2.lm3)
Anovalm3

##---Now Change the order and add b first in model
Exam5.2.lm4 <-
  lm(
      formula     = y~  b
    , data        = DataSet5.2
 #  , subset
 #  , weights
 #  , na.action
    , method      = "qr"
    , model       = TRUE
 #  , x           = FALSE
 #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
 #  , offset
 #  , ...
  )
summary( Exam5.2.lm4 )
(Lsm5.2lm4    <-
  lsmeans::lsmeans(
      object  = Exam5.2.lm4
    , specs   = "b"
    # , ...
  )
)
## lsmeans::contrast(object = Lsm5.2lm4, method = "pairwise")
Anovalm4  <-  anova(object   = Exam5.2.lm4)

##---then adding factor a in model
Exam5.2.lm5 <-
  lm(
      formula     = y~ b + a
    , data        = DataSet5.2
 #  , subset
 #  , weights
```

```
 #  , na.action
    , method      = "qr"
    , model       = TRUE
 #  , x           = FALSE
 #  , y           = FALSE
    , qr          = TRUE
    , singular.ok = TRUE
    , contrasts   = NULL
 #  , offset
 #  , ...
  )
summary( Exam5.2.lm5 )
(Lsm5.2lm5    <-
  lsmeans::lsmeans(
      object  = Exam5.2.lm5
    , specs   = "a"
    # , ...
  )
)
## lsmeans::contrast(object = Lsm5.2lm3, method = "pairwise")
Anovalm5  <-  anova(object   = Exam5.2.lm5)
Anovalm5
```

`Exam5.3` *Example 5.3 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-172)*

Description

Exam5.3 Inference using empirical standard error with different Bias connection

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012). *Generalized Linear Mixed Models: Modern Concepts, Methods and Applications*. CRC Press.

See Also

DataSet4.1

Examples

```
data(DataSet4.1)
DataSet4.1$trt   <- factor(x = DataSet4.1$trt)
DataSet4.1$block <- factor( x = DataSet4.1$block)

##---REML estimates on page 172
library(lme4)
# library(lmerTest)
Exam5.3REML      <-
  lmer(
         formula    = y ~ trt + (1|block)
       , data       = DataSet4.1
       , REML       = TRUE
    #  , control    = lmerControl()
       , start      = NULL
    #  , verbose    = 0L
    #  , subset
    #  , weights
    #  , na.action
    #  , offset
       , contrasts  = NULL
       , devFunOnly = FALSE
    #  , ...
  )
##---Standard Error Type "Model Based" with no Bias Connection
AnovaExam5.3REML  <- anova( object = Exam5.3REML )
AnovaExam5.3REML

##---Standard Error Type "Model Based" with "Kenward-Roger approximation" Bias Connection
# library(pbkrtest)
anova( object = Exam5.3REML, ddf  = "Kenward-Roger")

##---ML estimates on page 172
Exam5.3ML      <-
  lmer(
        formula      = y ~ trt + ( 1|block )
       , data        = DataSet4.1
       , REML        = FALSE
   #   , control     = lmerControl()
       , start       = NULL
   #   , verbose     = 0L
   #   , subset
   #   , weights
   #   , na.action
   #   , offset
       , contrasts   = NULL
       , devFunOnly  = FALSE
   #   , ...
  )

##---Standard Error Type "Model Based" with no Bias Connection
```

```
AnovaExam5.3ML  <- anova( object = Exam5.3ML )
AnovaExam5.3ML

##---Standard Error Type "Model Based" with "Kenward-Roger approximation" Bias Connection
anova( object = Exam5.3ML, ddf = "Kenward-Roger")
```

`Table1.1` *Data for Table1.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup*

Description

`Exam1.1` is used for inspecting probability distribution and to define a plausible process.

Usage

```
data(Table1.1)
```

Format

A `data.frame` with 11 rows and 3 variables.

Details

- x independent variable
- Nx bernouli trials(bernouli outcomes on each individual)
- y number of successes on each individual

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

`Exam1.1`

Examples

```
data(Table1.1)
```

Table1.2 *Data for Table1.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup(p-10)*

Description

Exam1.2 is used to see types of model effects by plotting regression data

Usage

```
data(Table1.2)
```

Format

A `data.frame` with 36 rows and 5 variables.

Details

- X have 11 levels in varying intervals from 0 to 48 observed for multiple batches
- Y continuous variable observed at each level of X
- Fav number of successes
- N number of bernoulli trials
- Batch Batches as 1, 2, 3, 4

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)
2. Adeela Munawar (<adeela.uaf@gmail.com>)

References

1. Stroup, W. W. (2012).*Generalized linear mixed models: modern concepts, methods and applications*. CRC press.

See Also

Exam1.2

Examples

```
data(Table1.2)
```

Index

∗ **datasets**
DataExam2.B.2, 2
DataExam2.B.3, 3
DataExam2.B.4, 4
DataExam2.B.7, 5
DataSet3.1, 6
DataSet3.2, 7
DataSet3.3, 8
DataSet4.1, 9
DataSet5.1, 10
DataSet5.2, 11
Exam1.1, 12
Exam1.2, 16
Exam2.B.1, 17
Exam2.B.2, 18
Exam2.B.3, 19
Exam2.B.4, 21
Exam2.B.5, 22
Exam2.B.6, 24
Exam2.B.7, 25
Exam3.2, 27
Exam3.3, 29
Exam3.5, 32
Exam3.9, 34
Exam4.1, 37
Exam5.1, 39
Exam5.2, 42
Exam5.3, 45
Table1.1, 47
Table1.2, 48

DataExam2.B.2, 2, *19*
DataExam2.B.3, 3, *20*
DataExam2.B.4, 4, *21*
DataExam2.B.7, 5, *25*
DataSet3.1, 6, *28*
DataSet3.2, 7, *29*, *33*, *35*
DataSet3.3, 8
DataSet4.1, 9, *37*, *45*
DataSet5.1, 10, *39*
DataSet5.2, 11, *42*

Exam1.1, 12, *47*
Exam1.2, 16, *48*
Exam2.B.1, 17
Exam2.B.2, *3*, 18
Exam2.B.3, *4*, 19
Exam2.B.4, *4*, 21
Exam2.B.5, 22
Exam2.B.6, 24
Exam2.B.7, *5*, 25
Exam3.2, *6*, 27
Exam3.3, *7*, 29
Exam3.5, 32
Exam3.9, *7*, 34
Exam4.1, *9*, 37
Exam5.1, *10*, 39
Exam5.2, *11*, 41
Exam5.3, 45

Table1.1, *12*, *17*, 47
Table1.2, *17*, *22*, *24*, 48