

# 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

**License** GPL-2

**URL** <https://github.com/MYaseen208/StroupGLMM>

**LazyData** TRUE

**RoxygenNote** 5.0.1.9000

**NeedsCompilation** no

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DataExam2.B.2	<i>Data for Example 2.B.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup (p-54)</i>
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### 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	<i>Data for Example 3.1 and Example 3.2 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup</i>
------------	---

---

**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 is independent 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 design
- trt treatments representing incomplete block design
- 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 overcome 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 family=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)

#-----
## Individual 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(lsmmeans)
(Lsm3.9fm1 <-
  lsmmeans::lsmmeans(
    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(lsmmeans)
##---A first
( Lsm5.2.lm1 <-
```

```

lsmeans::lsmeans(
  object = Exam5.2.lm1
  , specs = "a"
  # , ...
)
)
## lsmeans::contrast(object = Lsm5.2lm1 , method = "pairwise")
Anova1m1 <- anova(object = Exam5.2.lm1)
Anova1m1

##---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")
Anova1m2 <- anova(object = Exam5.2.lm2)
Anova1m2

##---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")
Anova1m3 <- anova(object = Exam5.2.lm3)
Anova1m3

##---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")
Anova1m4 <- 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")
Anova1m5 <- anova(object = Exam5.2.lm5)
Anova1m5

```

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	<i>Data for Table1.1 from Generalized Linear Mixed Models: Modern Concepts, Methods and Applications by Walter W. Stroup</i>
----------	--

---

**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)
```



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