

Package ‘VetResearchLMM’

July 21, 2025

Type Package

Title Linear Mixed Models - An Introduction with Applications in
Veterinary Research

Version 1.0.0

Maintainer Muhammad Yaseen <myaseen208@gmail.com>

Description R Codes and Datasets for Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Live-stock Research Institute.

Depends R (>= 3.1)

Imports ggplot2, lme4, nlme, lmerTest, multcomp

License GPL-2

URL <https://github.com/MYaseen208/VetResearchLMM>

LazyData TRUE

RoxygenNote 6.0.1

Note Department of Mathematics and Statistics, University of
Agriculture Faisalabad, Faisalabad-Pakistan.

NeedsCompilation no

Author Muhammad Yaseen [aut, cre],
Luc Duchateau [ctb],
Paul Janssen [ctb],
John Rowlands [ctb]

Repository CRAN

Date/Publication 2018-04-22 05:44:50 UTC

Contents

ex121	2
ex124	3
ex125	4
ex127	5

ex31	6
ex32	7
ex33	8
Examp1.3.2	9
Examp2.4.2.2	10
Examp2.4.3.1	12
Examp2.5.1.1	13
Examp2.5.2.1	14
Examp2.5.3.1	16
Examp2.5.4.1	18
Examp2.6.1	19
Examp3.1	21
Examp3.2	23
Examp3.3	25

Index 29

ex121	<i>ex121 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.</i>
-------	---

Description

ex121 is.

Usage

data(ex121)

Format

A data.frame with 40 rows and 4 variables.

Details

- herd two treatment 0 and 1
- drug unit of observation or observation ID
- dose is continuous \& may be assumed Gaussian
- PCVDif is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).*Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

Examples

```
data(ex121)
```

ex124	<i>ex124 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.</i>
-------	---

Description

ex124 is.

Usage

```
data(ex124)
```

Format

A data.frame with 40 rows and 4 variables.

Details

- herd two treatment 0 and 1
- drug unit of observation or observation ID
- dose is continuous \& may be assumed Gaussian
- PCVDif is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).*Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

See Also

[Examp1.3.2](#)

Examples

```
data(ex124)
```

ex125	<i>ex125 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.</i>
-------	---

Description

ex125 is.

Usage

```
data(ex125)
```

Format

A data.frame with 40 rows and 4 variables.

Details

- herd two treatment 0 and 1
- drug unit of observation or observation ID
- dose is continuous \& may be assumed Gaussian
- PCVDif is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).*Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

See Also

[Examp1.3.2](#)

Examples

```
data(ex125)
```

ex127	<i>ex127 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.</i>
-------	---

Description

ex127 is.

Usage

```
data(ex127)
```

Format

A data.frame with 40 rows and 4 variables.

Details

- herd two treatment 0 and 1
- drug unit of observation or observation ID
- dose is continuous \& may be assumed Gaussian
- PCVDif is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).*Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

See Also

[Examp1.3.2](#)

Examples

```
data(ex127)
```

ex31	<i>ex31 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.</i>
------	--

Description

ex31 is.

Usage

```
data(ex31)
```

Format

A data.frame with 38 rows and 6 variables.

Details

- herd Herds of Cattle
- animal_id Animal ID
- PCV1 Packed Cell Volume (PCV) determined at the time of treatment
- PCV2 Packed Cell Volume (PCV) determined at a month later following treatment
- dose Dose of Drugs
- drug Two drugs against trypanosomosis, Berenil and Samorin, are studied

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).*Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

See Also

[Examp1.3.2](#)

Examples

```
data(ex31)
```

ex32	<i>ex32 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.</i>
------	--

Description

ex32 is.

Usage

```
data(ex32)
```

Format

A data.frame with 40 rows and 4 variables.

Details

- herd two treatment 0 and 1
- drug unit of observation or observation ID
- dose is continuous \& may be assumed Gaussian
- PCVDif is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).*Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

See Also

[Examp1.3.2](#)

Examples

```
data(ex32)
```

ex33	<i>ex33 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.</i>
------	--

Description

ex33 is.

Usage

```
data(ex33)
```

Format

A data.frame with 40 rows and 4 variables.

Details

- herd two treatment 0 and 1
- drug unit of observation or observation ID
- dose is continuous \& may be assumed Gaussian
- PCVDif is the number of "successes"(N and F specify a binomial response)

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998).*Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

See Also

[Examp1.3.2](#)

Examples

```
data(ex33)
```

Examp1.3.2

#' @title Examp1.3.2 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.*

Description

Examp1.3.2 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research.* International Livestock Research Institute.

See Also

[ex124](#)

Examples

```
#-----
## Example 1.3.2 p-16
#-----
# PROC GLM DATA=ex124;
# CLASS herd dose drug;
# MODEL PCVdif=drug herd(drug) dose dose*drug;
# RANDOM herd(drug);
# RUN;

library(lme4)
str(ex124)
summary(ex124)

ex124$herd1 <- factor(ex124$herd)
ex124$drug1 <- factor(ex124$drug)
ex124$dose1 <- factor(ex124$dose)

fm1.1 <-
  aov(
    formula      = PCVdif ~ drug1 + Error(herd1:drug1) + dose1 + dose1:drug1
    , data        = ex124
    , projections = FALSE
    , qr          = TRUE
```

```

    , contrasts = NULL
#   , ...
)
summary(fm1.1)

```

Examp2.4.2.2

Examp2.4.2.2 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp2.4.2.2 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```

#-----
## Example 2.4.2.2 p-64
#-----
# PROC MIXED DATA=ex125 METHOD=ML;
# CLASS drug dose region;
# MODEL pcv=drug dose drug*dose;
# RANDOM region drug*region;
# RUN;
#
# PROC MIXED DATA=ex125 METHOD=REML;
# CLASS drug dose region;
# MODEL pcv=drug dose drug*dose;
# RANDOM region drug*region;
# RUN;

library(lme4)
str(ex125)

```

```

fm2.4 <-
  lme4::lmer(
    formula    = Pcv ~ dose*Drug + (1|Region/Drug)
    , data      = ex125
    , REML      = FALSE
    , control   = lmerControl()
    , start     = NULL
    , verbose   = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts  = NULL
    , devFunOnly = FALSE
    # , ...
  )
summary(fm2.4)
anova(fm2.4)

fm2.5 <-
  lme4::lmer(
    formula    = Pcv ~ dose*Drug + (1|Region/Drug)
    , data      = ex125
    , REML      = TRUE
    , control   = lmerControl()
    , start     = NULL
    , verbose   = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts  = NULL
    , devFunOnly = FALSE
    # , ...
  )
summary(fm2.5)
anova(fm2.5)

library(lmerTest)

fm2.6 <-
  lmerTest::lmer(
    formula    = Pcv ~ dose*Drug + (1|Region/Drug)
    , data      = ex125
    , REML      = FALSE
    , control   = lmerControl()
    , start     = NULL
    , verbose   = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts  = NULL

```

```

      , devFunOnly = FALSE
    # , ...
  )
summary(fm2.6)
anova(fm2.6)

fm2.7 <-
  lmerTest::lmer(
    formula      = Pcv ~ dose*Drug + (1|Region/Drug)
    , data        = ex125
    , REML        = TRUE
    , control     = lmerControl()
    , start       = NULL
    , verbose     = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts   = NULL
    , devFunOnly = FALSE
    # , ...
  )
summary(fm2.7)
anova(fm2.7)

```

Examp2.4.3.1

Examp2.4.3.1 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp2.4.3.1 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```

#-----
## Example 2.4.3.1 p-66
#-----
# PROC MIXED DATA=ex127;
# CLASS sire;
# MODEL ww=;
# RANDOM sire/solution;
# RUN;

library(lme4)
str(ex127)
fm2.8 <-
  lme4::lmer(
    formula = Ww~(1|sire)
    , data = ex127
    , REML = TRUE
    , control = lmerControl()
    , start = NULL
    , verbose = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts = NULL
    , devFunOnly = FALSE
    # , ...
  )
summary(fm2.8)
lme4::fixef(fm2.8)
lme4::ranef(fm2.8)

```

Examp2.5.1.1

Examp2.5.1.1 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp2.5.1.1 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```
#-----
## Example 2.5.1.1 p-67
#-----
# PROC MIXED DATA=ex125;
# CLASS drug dose region;
# MODEL pcv=drug dose drug*dose / solution covb;
# RANDOM region drug*region;
# RUN;

library(lme4)
str(ex125)

fm2.9 <-
  lme4::lmer(
    formula   = Pcv ~ dose*Drug + (1|Region/Drug)
    , data     = ex125
    , REML     = TRUE
    , control  = lmerControl()
    , start    = NULL
    , verbose  = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts = list(dose = "contr.SAS", Drug = "contr.SAS")
    , devFunOnly = FALSE
    # , ...
  )
summary(fm2.9)
anova(fm2.9)
summary(fm2.9)$vcov
```

Description

Examp2.5.2.1 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```
#-----
## Example 2.5.2.1 p-68
#-----
# PROC MIXED DATA=ex125;
# CLASS drug dose region;
# MODEL pcv=drug dose drug*dose / solution covb;
# RANDOM region drug*region;
# LSMEANS drug*dose;
# RUN;

library(lmerTest)
str(ex125)

fm2.10 <-
  lmerTest::lmer(
    formula    = Pcv ~ dose*Drug + (1|Region/Drug)
    , data      = ex125
    , REML      = TRUE
    , control    = lmerControl()
    , start      = NULL
    , verbose    = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts = list(dose = "contr.SAS", Drug = "contr.SAS")
    , devFunOnly = FALSE
    # , ...
  )
summary(fm2.10)
anova(fm2.10)
summary(fm2.10)$vcov
lsmeansLT(model = fm2.10)
```

Examp2.5.3.1

Examp2.5.3.1 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp2.5.3.1 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```
#-----
## Example 2.5.3.1 p-70
#-----

# PROC GLM DATA=ex125;
# CLASS drug dose region;
# MODEL pcv=region drug region*drug dose drug*dose;
# RANDOM region drug*region;
# RUN;

# PROC MIXED DATA=ex125;
# CLASS drug dose region;
# MODEL pcv=drug dose drug*dose / ddfm=satterth;
# RANDOM region drug*region;
# ESTIMATE 'drug dif' drug -1 1 drug*dose -0.5 -0.5 0.5 0.5;
# ESTIMATE 'Samorin mean' INTERCEPT 1 drug 0 1 dose 0.5 0.5
#                                drug*dose 0 0 0.5 0.5;
# ESTIMATE 'Samorin HvsL' dose 1 -1 drug*dose 0 0 1 -1;
# ESTIMATE 'Samorin high' INTERCEPT 1 drug 0 1 dose 1 0
#                                drug*dose 0 0 1 0;
# RUN;

library(lme4)
str(ex125)
```

```

ex125$Region1 <- factor(ex125$Region)
fm2.11 <-
  aov(
    formula      = Pcv ~ Region1 + Drug + Error(Drug:Region1) + dose + dose:Drug
    , data        = ex125
    , projections = FALSE
    , qr          = TRUE
    , contrasts    = NULL
    # , ...
  )
summary(fm2.11)

fm2.12 <-
  lmerTest::lmer(
    formula      = Pcv ~ dose*Drug + (1|Region/Drug)
    , data        = ex125
    , REML        = TRUE
    , control     = lmerControl()
    , start       = NULL
    , verbose     = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts    = list(dose = "contr.SAS", Drug = "contr.SAS")
    , devFunOnly  = FALSE
    # , ...
  )
summary(fm2.12)
anova(object = fm2.12, ddf = "Satterthwaite")

library(multcomp)
Contrasts1 <-
  matrix(c(
    1, 0.5, 0, 0
    , 0, 0, -1, -0.5
    , 1, 1, 0, 0
    , 0, 1, 0, 0
  )
    , ncol = 4
    , byrow = TRUE
    , dimnames = list(
      c("C1", "C2", "C3", "C4")
      , rownames(summary(fm2.12)$coef)
    )
  )

Contrasts1
summary(glht(fm2.12, linfct=Contrasts1))

```

Examp2.5.4.1

Examp2.5.4.1 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp2.5.4.1 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```
#-----
## Example 2.5.4.1 p-74
#-----
# PROC MIXED DATA=ex125;
# CLASS drug dose region;
# MODEL pcv=drug dose drug*dose / ddfm=satterth;
# RANDOM region drug*region;
# ESTIMATE 'Samorin mean' INTERCEPT 1 drug 0 1 dose 0.5 0.5
#               drug*dose 0 0 0.5 0.5;
# RUN;

# PROC GLM DATA=ex125;
# CLASS drug dose region;
# MODEL pcv=region drug region*drug dose drug*dose;
# ESTIMATE 'Samorin mean' INTERCEPT 1 drug 0 1 dose 0.5 0.5
#               drug*dose 0 0 0.5 0.5;
# RUN;

library(lme4)
str(ex125)
ex125$Region1 <- factor(ex125$Region)
fm2.13 <-
  lmerTest::lmer(
    formula    = Pcv ~ dose*Drug + (1|Region/Drug)
```

```

      , data      = ex125
      , REML      = TRUE
      , control   = lmerControl()
      , start     = NULL
      , verbose   = 0L
#   , subset
#   , weights
#   , na.action
#   , offset
      , contrasts = list(dose = "contr.SAS", Drug = "contr.SAS")
      , devFunOnly = FALSE
#   , ...
    )
summary(fm2.13)

library(multcomp)
Contrasts2 <-
  matrix(c(
    1, 0.5, 0, 0
  ),
    , ncol = 4
    , byrow = TRUE
    , dimnames = list(
      c("C5")
      , rownames(summary(fm2.13)$coef)
    )
  )

Contrasts2
summary(glht(fm2.13, linfct=Contrasts2))

```

Examp2.6.1

Examp2.6.1 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp2.6.1 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also[ex124](#)**Examples**

```

#-----
## Example 2.6.1 p-76
#-----
# PROC MIXED DATA=ex125;
# CLASS drug dose region;
# MODEL pcv=drug dose drug*dose / ddfm=satterth;
# RANDOM region drug*region;
# CONTRAST 'drug dif' drug -1 1 drug*dose -0.5 -0.5 0.5 0.5;
# CONTRAST 'all' drug 1 -1 dose 0 0 drug*dose 0.5 0.5 -0.5 -0.5,
#           drug 0 0 dose 1 -1 drug*dose 0.5 -0.5 0.5 -0.5,
#           drug 0 0 dose 0 0 drug*dose 0.5 -0.5 -0.5 0.5;
# RUN;

library(lmerTest)
str(ex125)
ex125$Region1 <- factor(ex125$Region)
fm2.14 <-
  lmerTest::lmer(
    formula      = Pcv ~ dose*Drug + (1|Region/Drug)
    , data       = ex125
    , REML       = TRUE
    , control    = lmerControl()
    , start      = NULL
    , verbose    = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts   = list(dose = "contr.SAS", Drug = "contr.SAS")
    , devFunOnly = FALSE
    # , ...
  )
summary(fm2.14)
anova(object = fm2.14, ddf = "Satterthwaite")

library(multcomp)
Contrasts3 <-
  matrix(c(
    0, 0, -1, -0.5
  )
    , ncol = 4
    , byrow = TRUE
    , dimnames = list(
      c("C1")
      , rownames(summary(fm2.14)$coef)
    )
  )

```

```

Contrasts3
summary(gllt(fm2.14, linfo=Contrasts3))

if(packageVersion("lmerTest") >= "3.0")
  contest(fm2.14, Contrasts3, joint = FALSE)

```

Examp3.1

Examp3.1 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp3.1 is.

Author(s)

1. Muhammad Yaseen (<myaseen208@gmail.com>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```

#-----
## Example 3.1 Model 1 p=80
#-----
# PROC MIXED DATA=ex31;
# CLASS drug dose herd;
# MODEL PCV2=drug dose(drug)/solution ddfm=satterth;
# RANDOM herd(drug);
# ESTIMATE 'Mean Samorin' intercept 1 drug 0 1 dose(drug) 0 0 1;
# ESTIMATE 'Berenil 2 doses' dose(drug) 1 -1 0;
# ESTIMATE 'Ber vs Sam at dose 1' drug 1 -1 dose(drug) 1 0 -1;
# CONTRAST 'Mean Samorin' intercept 1 drug 0 1 dose(drug) 0 0 1;
# CONTRAST 'Berenil dif 2 doses' dose(drug) 1 -1 0;
# CONTRAST 'Ber vs Sam at dose 1' drug 1 -1 dose(drug) 1 0 -1;
# CONTRAST 'some difference' drug 1 -1 dose(drug) 0.5 0.5 -1,
#       drug 0 0 dose(drug) 1 -1 0;
# LSMEANS dose(drug);
# RUN;

```

```

library(lmerTest)
str(ex31)
ex31$drug1 <- factor(ex31$drug)
ex31$dose1 <- factor(ex31$dose)
ex31$herd1 <- factor(ex31$herd)

fm3.1 <-
  lmerTest::lmer(
    formula = PCV2 ~ drug1 + dose1:drug1 + (1|herd1:drug1)
    , data = ex31
    , REML = TRUE
    , control = lmerControl()
    , start = NULL
    , verbose = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts = list(dose1 = "contr.SAS", drug1 = "contr.SAS")
    , devFunOnly = FALSE
    # , ...
  )
summary(fm3.1)
anova(object = fm3.1, ddf = "Satterthwaite")
lsmeansLT(model = fm3.1, test.egfs = "dose1:drug1")

#-----
## Example 3.1 Model 2 p-84
#-----
# PROC MIXED DATA=ex31;
# CLASS drug dose herd;
# MODEL PCV2=PCV1 drug dose(drug)/solution ddfm=satterth;
# RANDOM herd(drug);
# RUN;

library(lmerTest)
str(ex31)
ex31$drug1 <- factor(ex31$drug)
ex31$dose1 <- factor(ex31$dose)
ex31$herd1 <- factor(ex31$herd)

fm3.2 <-
  lmerTest::lmer(
    formula = PCV2 ~ PCV1 + drug1 + dose1:drug1 + (1|herd1:drug1)
    , data = ex31
    , REML = TRUE
    , control = lmerControl()
    , start = NULL
    , verbose = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
  )

```

```

      , contrasts = list(dose1 = "contr.SAS", drug1 = "contr.SAS")
      , devFunOnly = FALSE
    # , ...
  )
summary(fm3.2)
anova(object = fm3.2, ddf = "Satterthwaite")
lsmeansLT(model = fm3.2, test.effs = "herd1:drug1")

#-----
## Example 3.1 Model 3 p-86
#-----
# PROC MIXED DATA=ex31;
# CLASS drug dose herd;
# MODEL PCV2=drug dose(drug) PCV1*dose(drug)/solution ddfm=satterth;
# RANDOM herd(drug);
# RUN;

library(lmerTest)
str(ex31)
ex31$drug1 <- factor(ex31$drug)
ex31$dose1 <- factor(ex31$dose)
ex31$herd1 <- factor(ex31$herd)

fm3.3 <-
  lmerTest::lmer(
    formula = PCV2 ~ drug1 + PCV1*dose1:drug1 + (1|herd1:drug1)
    , data = ex31
    , REML = TRUE
    , control = lmerControl()
    , start = NULL
    , verbose = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts = list(dose1 = "contr.SAS", drug1 = "contr.SAS")
    , devFunOnly = FALSE
    # , ...
  )
summary(fm3.3)
anova(object = fm3.3, ddf = "Satterthwaite")
lsmeansLT(model = fm3.3, test.effs = "dose1:drug1")

```

Description

Examp3.2 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```
#-----
## Example 3.3 p-88
#-----
# PROC MIXED DATA=ex32;
# CLASS sex sire_id breed;
# MODEL ww = sex agew breed/SOLUTION DDFM=SATTERTH;
# RANDOM sire_id(breed)/SOLUTION;
# LSMEANS breed/ADJUST = TUKEY;
# RUN;

library(lmerTest)
str(ex32)
ex32$sire_id1 <- factor(ex32$sire_id)
ex32$breed1 <- factor(ex32$breed)

fm3.4 <-
  lmerTest::lmer(
    formula = Ww ~ sex + agew + breed1 + (1|sire_id1:breed1)
    , data = ex32
    , REML = TRUE
    , control = lmerControl()
    , start = NULL
    , verbose = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    , contrasts = list(sex = "contr.SAS", breed1 = "contr.SAS")
    , devFunOnly = FALSE
    # , ...
  )
summary(fm3.4)
anova(object = fm3.4, ddf = "Satterthwaite")
```

```
lsmeansLT(model = fm3.4)
```

Examp3.3

Examp3.3 from Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). Linear Mixed Models. An Introduction with applications in Veterinary Research. International Livestock Research Institute.

Description

Examp3.3 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>)

References

1. Duchateau, L. and Janssen, P. and Rowlands, G. J. (1998). *Linear Mixed Models. An Introduction with applications in Veterinary Research*. International Livestock Research Institute.

See Also

[ex124](#)

Examples

```
#-----
## Example 3.3 Model 1 p-88
#-----
# PROC MIXED DATA=ex33;
# CLASS breed animal_id;
# MODEL pcv = breed breed*time/SOLUTION;
# RANDOM animal_id(breed)/SOLUTION;
# RUN;

library(lme4)
options(contrasts = c(factor = "contr.SAS", ordered = "contr.poly"))
str(ex33)

fm3.5 <-
lme4::lmer(
  formula    = PCV ~ breed + breed*time + (1|animal_id:breed)
  , data      = ex33
  , REML      = TRUE
  , control   = lmerControl()
  , start     = NULL
  , verbose   = 0L
  # , subset
```

```

# , weights
# , na.action
# , offset
# , contrasts = list(breed = "contr.SAS")
# , devFunOnly = FALSE
# , ...
)
summary(fm3.5)
anova(fm3.5)

library(lmerTest)
fm3.6 <-
  lmerTest::lmer(
    formula = PCV ~ breed + breed:time + (1|animal_id:breed)
    , data = ex33
    , REML = TRUE
    , control = lmerControl()
    , start = NULL
    , verbose = 0L
    # , subset
    # , weights
    # , na.action
    # , offset
    # , contrasts = list(breed = "contr.SAS")
    # , devFunOnly = FALSE
    # , ...
  )
summary(fm3.6)
anova(object = fm3.6, ddf = "Satterthwaite")

# PROC MIXED DATA=ex33;
# CLASS breed animal_id;
# MODEL pcv = breed breed*time/SOLUTION;
# REPEATED/TYPE=CS SUB = animal_id(breed) R;
# RUN;

library(nlme)
fm3.7 <-
  nlme::glsl(
    model = PCV ~ breed + breed:time
    , data = ex33
    , correlation = corCompSymm(, form = ~ 1|animal_id/breed)
    , weights = NULL
    # , subset =
    , method = "REML" # c("REML", "ML")
    , na.action = na.fail
    , control = list()
  )
summary(fm3.7)
anova(fm3.7)

```

```

# PROC MIXED DATA=ex33;
# CLASS breed animal_id;
# MODEL pcv = time breed breed*time/SOLUTION;
# RANDOM animal_id(breed)/SOLUTION;
# RUN;

fm3.8 <-
lme4::lmer(
  formula    = PCV ~ time + breed + breed*time + (1|animal_id:breed)
, data      = ex33
, REML      = TRUE
, control    = lmerControl()
, start      = NULL
, verbose    = 0L
# , subset
# , weights
# , na.action
# , offset
, contrasts  = list(breed = "contr.SAS")
, devFunOnly = FALSE
# , ...
)
summary(fm3.8)
anova(fm3.8)

fm3.9 <-
lmerTest::lmer(
  formula    = PCV ~ time + breed + breed*time + (1|animal_id:breed)
, data      = ex33
, REML      = TRUE
, control    = lmerControl()
, start      = NULL
, verbose    = 0L
# , subset
# , weights
# , na.action
# , offset
, contrasts  = list(breed = "contr.SAS")
, devFunOnly = FALSE
# , ...
)
summary(fm3.9)
anova(object = fm3.9, ddf = "Satterthwaite", type = 3)

# PROC MIXED DATA=ex33;
# CLASS breed animal_id;
# MODEL pcv = breed breed*time/SOLUTION;
# REPEATED/TYPE=AR(1) SUBJET = animal_id(breed) R;
# RUN;

```

```

library(nlme)
fm3.10 <-
  nlme::glS(
    model      = PCV ~ breed + breed:time
    , data      = ex33
    , correlation = corAR1(, form = ~ 1|animal_id/breed)
    , weights    = NULL
    # , subset    =
    , method     = "REML" # c("REML", "ML")
    , na.action  = na.fail
    , control    = list()
  )
summary(fm3.10)
anova(fm3.10)

# PROC MIXED DATA=ex33;
# CLASS breed animal_id;
# MODEL pcv = breed breed*time/SOLUTION;
# RANDOM INTERCEPT time/TYPE=UN SUBJET = animal_id(breed) SOLUTION;
# RUN;

library(nlme)
# fm3.11 <-
#   nlme::glS(
#     model      = PCV ~ breed + breed:time
#     , data      = ex33
#     , random     = ~1|animal_id/breed
#     , correlation = corAR1(, form = ~ 1|animal_id/breed)
#     , weights    = NULL
#     # , subset    =
#     , method     = "REML" # c("REML", "ML")
#     , na.action  = na.fail
#     , control    = list()
#   )
# summary(fm3.11)
# anova(fm3.11)

```

Index

* datasets

- ex121, [2](#)
- ex124, [3](#)
- ex125, [4](#)
- ex127, [5](#)
- ex31, [6](#)
- ex32, [7](#)
- ex33, [8](#)
- Examp1.3.2, [9](#)
- Examp2.4.2.2, [10](#)
- Examp2.4.3.1, [12](#)
- Examp2.5.1.1, [13](#)
- Examp2.5.2.1, [14](#)
- Examp2.5.3.1, [16](#)
- Examp2.5.4.1, [18](#)
- Examp2.6.1, [19](#)
- Examp3.1, [21](#)
- Examp3.2, [23](#)
- Examp3.3, [25](#)

- ex121, [2](#)
- ex124, [3](#), [9](#), [10](#), [12](#), [14–16](#), [18](#), [20](#), [21](#), [24](#), [25](#)
- ex125, [4](#)
- ex127, [5](#)
- ex31, [6](#)
- ex32, [7](#)
- ex33, [8](#)
- Examp1.3.2, [3–8](#), [9](#)
- Examp2.4.2.2, [10](#)
- Examp2.4.3.1, [12](#)
- Examp2.5.1.1, [13](#)
- Examp2.5.2.1, [14](#)
- Examp2.5.3.1, [16](#)
- Examp2.5.4.1, [18](#)
- Examp2.6.1, [19](#)
- Examp3.1, [21](#)
- Examp3.2, [23](#)
- Examp3.3, [25](#)