

# Package ‘VetResearchLMM’

April 4, 2017

**Type** Package

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

**Version** 0.2.0

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**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 (ISBN 92-9146-038-9).

**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

**NeedsCompilation** no

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**Repository** CRAN

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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>
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## 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>
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**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 *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.*

---

**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 *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.*

---

**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 *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.*

---

### 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 *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.*

---

**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 *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.*

---

**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 Row-
                lands, G. J. (1998).Linear Mixed Models. An Introduction with ap-
                plications 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
```

---

Examp2.5.2.1

*Examp2.5.2.1 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**

Examp2.5.2.1 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(lme4)
str(ex125)

fm2.10 <-
  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(fm2.10)
anova(fm2.10)
summary(fm2.10)$vcov
library(lmerTest)
```





```

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)
lmerTest::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(lme4)
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)
lmerTest::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(glm2(fm2.14, linfo=Contrasts3))
```

---

Examp3.1	<i>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.</i>
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---

### 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)
lmerTest::anova(object = fm3.1, ddf = "Satterthwaite")
lmerTest::lsmeansLT(model = fm3.1, test.offs = "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)
lmerTest::anova(object = fm3.2, ddf = "Satterthwaite")
lmerTest::lsmeansLT(model = fm3.2, test.offs = "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)
lmerTest::anova(object = fm3.3, ddf = "Satterthwaite")
lmerTest::lsmeansLT(model = fm3.3, test.offs = "dose1:drug1")

```

---

Examp3.2

*Examp3.2 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

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)
lmerTest::anova(object = fm3.4, ddf = "Satterthwaite")
lmerTest::lsmeansLT(model = fm3.4, test.effs = "breed1")

```



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)

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)
lmerTest::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::gls(
  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)
lmerTest::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)

```

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