I put my questions of 10.x ξ } _the last few pages._

5303hw08

Jin Yao

2019/10/30

E 11.1

(a)

```r
library(cfcdae)
data("Sires")
head(Sires)
```

```
##   bull gain
## 1    1 1.46
## 2    1 1.23
## 3    1 1.12
## 4    1 1.23
## 5    1 1.02
## 6    1 1.15
```
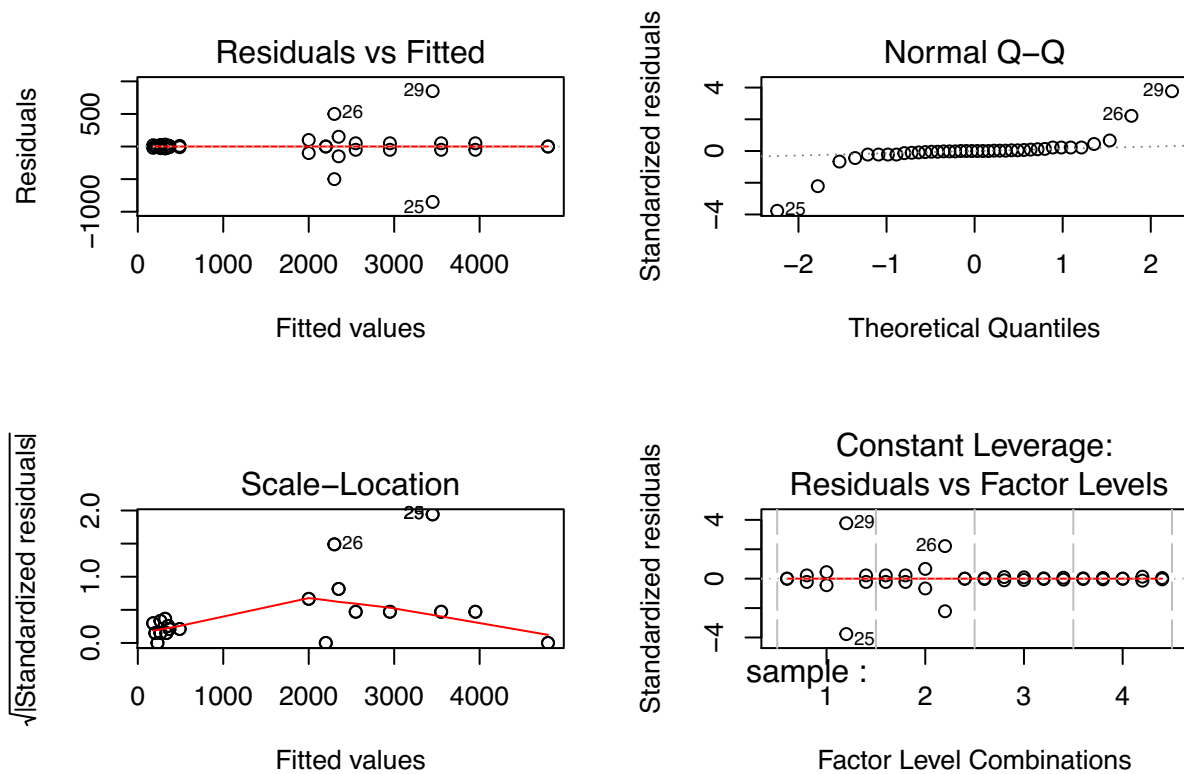
```r
library(lme4)
```

```
## Loading required package: Matrix
```

```r
mod1 <- lmer(gain~ 1+(1|bull),data=Sires,REML=T)
summary(mod1)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: gain ~ 1 + (1 | bull)
##    Data: Sires
##
## REML criterion at convergence: -23.5
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.6639 -0.5601  0.1081  0.5645  2.3859
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  bull     (Intercept) 0.005078 0.07126
##  Residual             0.015945 0.12627
## Number of obs: 24, groups:  bull, 4
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)  1.07667    0.04397   24.48
```

```r
library(RLRsim)
exactRLRT(mod1)
```

```
##
##   simulated finite sample distribution of RLRT.
##
```
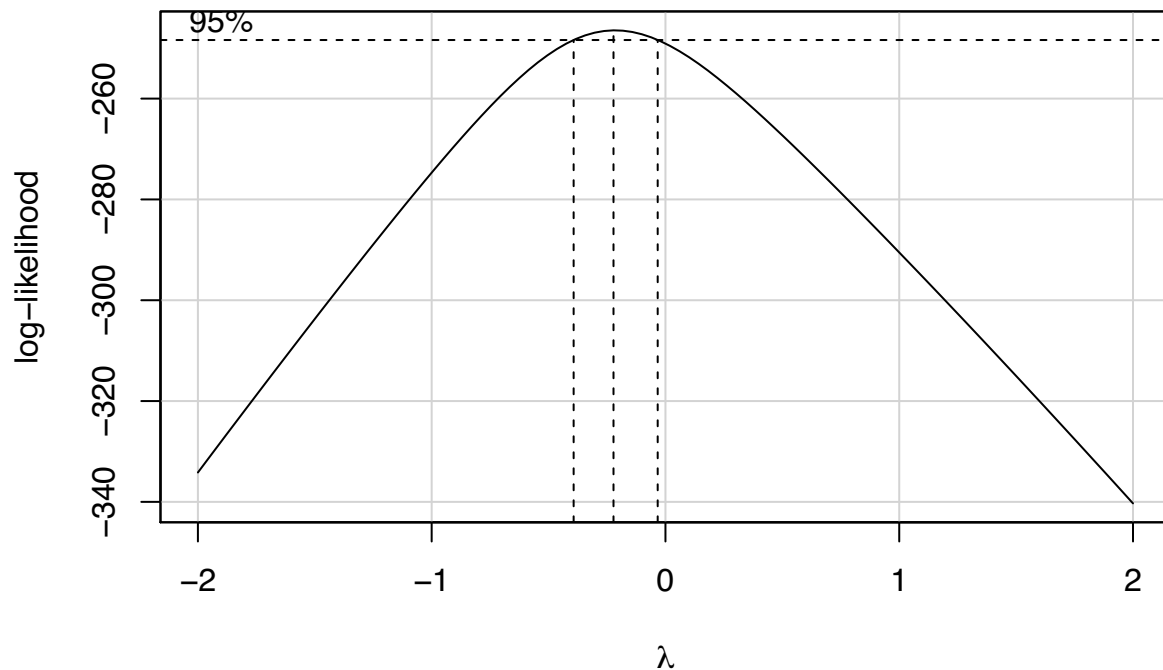
1

```
##  (p-value based on 10000 simulated values)
##
## data:
## RLRT = 1.9128, p-value = 0.0609
```

 # the p value is 0.0587, so we fail to reject the null, there is no significant variability.

(b)

```
confint(mod1,method="boot",oldNames=FALSE,level = 0.90)
```

```
## Computing bootstrap confidence intervals ...

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## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00419745
## (tol = 0.002, component 1)

## singular fit
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##                            5 %        95 %
## sd_(Intercept)|bull 0.00000000 0.1291612
## sigma               0.09239886 0.1571126
## (Intercept)         1.01087014 1.1538000
```

 # the 90% interval is 0.09191753 0.1565729 for sigma, and the variance is 0.00000000 0.1338055.

P 11.2

```
data("Interlaboratory")
head(Interlaboratory)
```

```
##   sample lab count
## 1      1   1  2200
## 2      2   1  3000
## 3      3   1   210
## 4      4   1   270
## 5      1   1  2200
## 6      2   1  2900
```

```
mod2 <- lm(count~sample*lab,data=Interlaboratory)
par(mfrow=c(2,2))
plot(mod2)
```

```r
library(car)
```

```
## Loading required package: carData
```

```r
par(mfrow=c(1,1))
boxCox(mod2)
```



```r
# may take log
mod21 =lmer(log(count)~1+(1|lab:sample)+(1|sample)+(1|lab), data = Interlaboratory)
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00354987
## (tol = 0.002, component 1)
mod22 = lmer(log(count)~1+(1|lab), data = Interlaboratory)

## singular fit
mod23 = lmer(log(count)~1+(1|lab:sample)+(1|sample), data = Interlaboratory)
exactRLRT(mod21,mod22,mod23)

##
##   simulated finite sample distribution of RLRT.
##
##   (p-value based on 10000 simulated values)
##
## data:
## RLRT = 0, p-value = 1
# p is very tiny, so lab is significant
mod22s = lmer(log(count)~1+(1|sample), data = Interlaboratory)
mod23s = lmer(log(count)~1+(1|lab:sample)+(1|lab), data = Interlaboratory)

## singular fit

exactRLRT(mod21,mod22s,mod23s)

##
##   simulated finite sample distribution of RLRT.
##
##   (p-value based on 10000 simulated values)
##
## data:
## RLRT = 16.124, p-value < 2.2e-16
# p is very tiny, so sample is significant
mod22i = lmer(log(count)~1+(1|lab:sample), data = Interlaboratory)
mod23i = lmer(log(count)~1+(1|sample)+(1|lab), data = Interlaboratory)
exactRLRT(mod21,mod22i,mod23i)

##
##   simulated finite sample distribution of RLRT.
##
##   (p-value based on 10000 simulated values)
##
## data:
## RLRT = 0, p-value = 1
# accroding to the question, we are mostly interested in the lab, so estimate it.
confint(mod21, method = "boot",oldNames = FALSE)

## Computing bootstrap confidence intervals ...

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00358256
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
```

```
## control$checkConv, : Model failed to converge with max|grad| = 0.00332958
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00248567
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00831202
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0192771
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00219035
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00342797
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00310041
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00208168
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00203201
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00341203
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00225879
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00285189
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00460392
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00660973
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0174033
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0029039
```

```
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00386751
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00393503
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00228373
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00298153
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00417788
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00281453
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00271258
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00228827
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00752355
## (tol = 0.002, component 1)

## singular fit

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0035444
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00267518
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00539734
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00210175
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00208715
```

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## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00527527
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00408425
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00236135
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00271136
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.040141
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00255014
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00421915
## (tol = 0.002, component 1)

## singular fit
## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00326464
## (tol = 0.002, component 1)

## singular fit
## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00959952
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00229368
## (tol = 0.002, component 1)

## singular fit
## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0378794
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00237363
## (tol = 0.002, component 1)
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00285951
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00377693
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00227623
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00517745
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00271887
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0142433
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00706201
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.018905
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00312585
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00254348
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00249119
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00246616
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00425847
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0214748
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00377038
```

```
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0032734
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00291319
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00251097
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00400415
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00352845
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00308224
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.0159877
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00263418
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00565874
## (tol = 0.002, component 1)

## singular fit

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00525174
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00450513
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00255083
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00238604
## (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00964014
## (tol = 0.002, component 1)
```
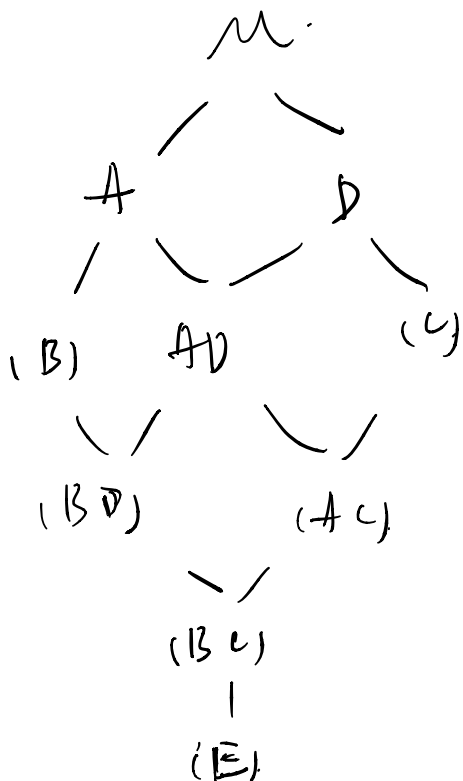
```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl =
## control$checkConv, : Model failed to converge with max|grad| = 0.00323707
## (tol = 0.002, component 1)

##                                  2.5 %      97.5 %
## sd_(Intercept)|lab:sample 6.060734e-05 0.1910977
## sd_(Intercept)|lab        4.666232e-02 0.4617352
## sd_(Intercept)|sample     3.518606e-01 2.2557013
## sigma                     8.725599e-02 0.1613392
## (Intercept)               5.446454e+00 8.1609152
```
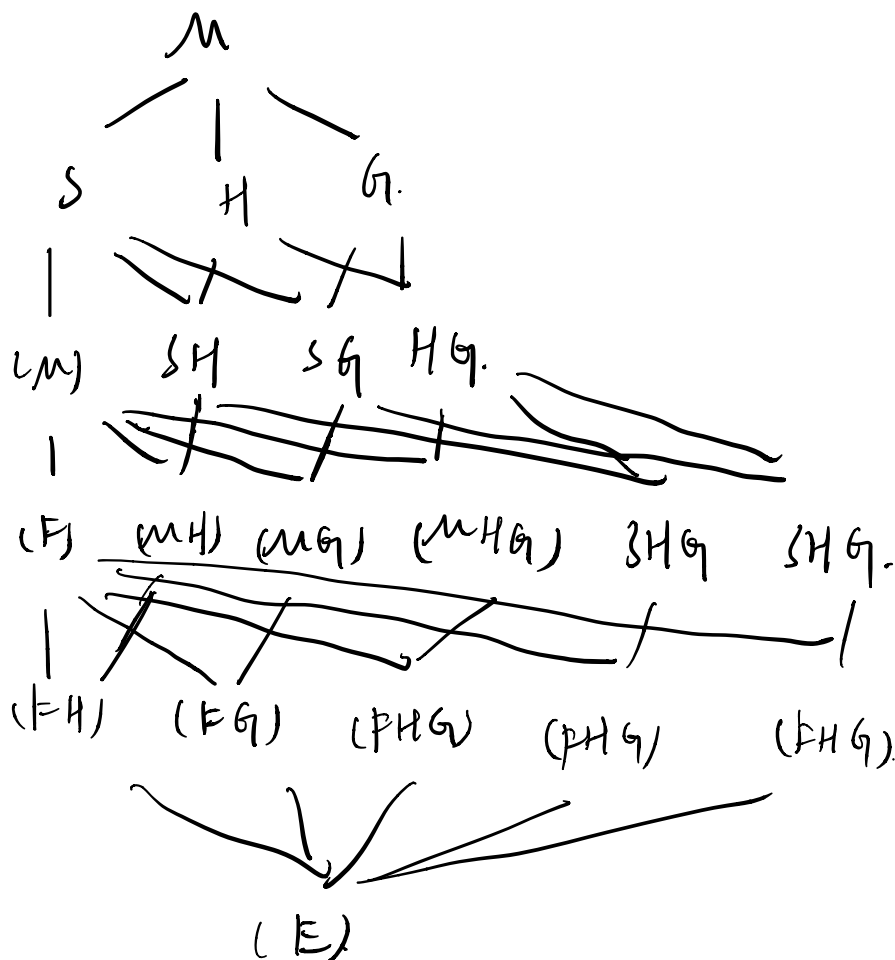
```r
summary(mod21)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: log(count) ~ 1 + (1 | lab:sample) + (1 | sample) + (1 | lab)
##    Data: Interlaboratory
##
## REML criterion at convergence: 0.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.70684 -0.31120  0.00956  0.39379  2.51142
##
## Random effects:
##  Groups     Name        Variance Std.Dev.
##  lab:sample (Intercept) 0.01490  0.1221
##  lab        (Intercept) 0.06618  0.2572
##  sample     (Intercept) 1.77425  1.3320
##  Residual               0.01541  0.1241
## Number of obs: 40, groups:  lab:sample, 20; lab, 5; sample, 4
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)   6.8156     0.6767   10.07
## convergence code: 0
## Model failed to converge with max|grad| = 0.00354987 (tol = 0.002, component 1)
```

```r
# the ci of the random lab effect is 0.030287979 0.4112245,
# the ci of the random sample effect is 0.313112363 2.4042654
# the ci of the random lab:sample effect is 0.007638445 0.1914905
```
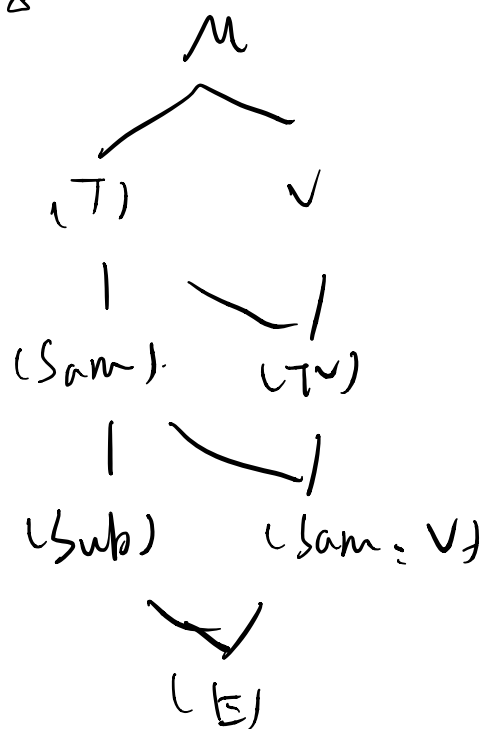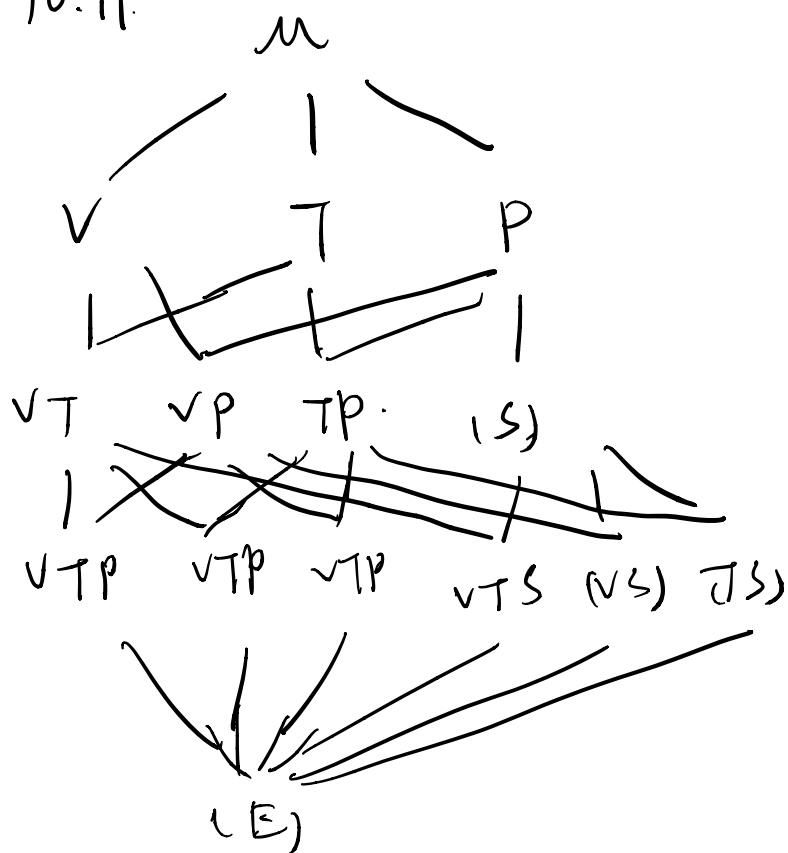
E 10-3.   A·D fixed·

```
              M·
            /    \
          A        D
        /   \    /   \
     (B)    AD       (C)
        \   /    \   /
        (BD)      (AC)
            \    /
            (BC)
              |
             (E)
```

P 10-3   Source.
cuales

```
                      M
                    / | \
                  S   H   G·
                  |   X   X
                 (M)  SH  SG  HG·
                  |
                 (F) (MH) (MG) (MHG)  BHG  SHG·
                  |
               (FH) (FG) (PHG) (PHG)  (FHG)·
                      \   \  /   /
                        (E)
```

P 10.8

M
(T)   V
| \ |
(Sam) (TV)
| \ |
(Sub) (Sam.V)
\ /
(E)

P 10.11.

M
V   T   P
VT VP TP. (S)
VTP VTP VTP VTS (VS) (TS)
(E)

M

(L)   P   T.

(F)   (LP)   (LT)   PT.

(FP)   (FT)   (FPT)   (LPT)

(E)

M

P   E.

(M)   PE

(F)   (M E)

(F E).

(E)