bm2_hw7

Yixiao Sun

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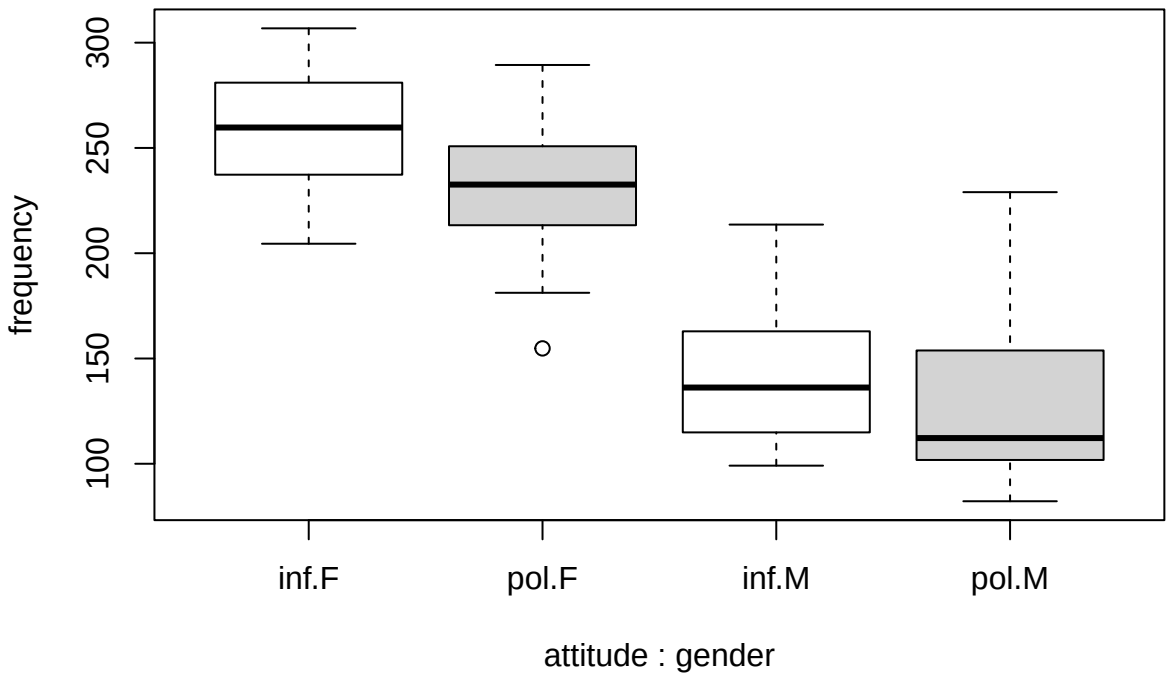
```
set.seed(1)
library(lme4)
```

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

```
rm(list = ls())
data <- read.csv('~/Desktop/P8130_Biostatistical Method/bw2_hw7/HW7-politeness_data.csv')
summary(data)
```

```
##    subject              gender             scenario   attitude
##  Length:84          Length:84          Min.   :1   Length:84
##  Class :character   Class :character   1st Qu.:2   Class :character
##  Mode  :character   Mode  :character   Median :4   Mode  :character
##                                        Mean   :4
##                                        3rd Qu.:6
##                                        Max.   :7
##    frequency
##  Min.   : 82.2
##  1st Qu.:126.8
##  Median :201.8
##  Mean   :192.6
##  3rd Qu.:247.4
##  Max.   :306.8
```

```
boxplot(frequency ~ attitude*gender, col=c("white","lightgray"),data= data)
```




```
m1 <- lmer(frequency ~ gender + attitude + (1|subject), REML = TRUE, data = data)
summary(m1)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: frequency ~ gender + attitude + (1 | subject)
##    Data: data
##
## REML criterion at convergence: 796.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.3564 -0.5658 -0.2012  0.4618  3.2998
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  subject  (Intercept) 598.2    24.46
##  Residual             847.7    29.12
## Number of obs: 84, groups:  subject, 6
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)  256.987     15.155  16.957
## genderM     -108.798     20.956  -5.192
## attitudepol  -20.002      6.353  -3.148
##
```

```
## Correlation of Fixed Effects:
##             (Intr) gendrM
## genderM     -0.691
## attitudepol -0.210  0.000
```

```
summary(ranef(m1)$subject)
```

```
##   (Intercept)
##  Min.   :-32.700
##  1st Qu.: -9.331
##  Median :  4.072
##  Mean   :  0.000
##  3rd Qu.:  8.813
##  Max.   : 27.960
```

```
ranef(m1)
```

```
## $subject
##    (Intercept)
## F1  -13.575832
## F2   10.170523
## F3    3.405309
## M3   27.960290
## M4    4.739325
## M7  -32.699615
##
## with conditional variances for "subject"
```

```
residuals(m1)
```

```
##           1           2           3           4           5           6
## -10.1086918 -38.9110728  61.6913082  16.2889272 -19.5086918  43.4889272
##           7           8           9          10          11          12
##  27.3913082  33.3889272   8.4913082   8.9889272 -42.2086918 -12.7110728
##          13          14          15          16          17          18
## -26.9110728 -68.6086918 -10.6898328 -23.0922138  -3.5898328  -9.3922138
##          19          20          21          22          23          24
##  26.6101672   5.6077862  35.0101672  46.4077862  -7.7898328  -7.8922138
##          25          26          27          28          29          30
## -13.8898328  18.4077862   4.0077862 -54.8898328 -22.2262301 -29.3286110
##          31          32          33          34          35          36
##  96.0737699 -38.0286110 -20.7262301  60.6713890  60.4737699   9.9713890
##          37          38          39          40          41          42
## -31.1262301 -26.0286110 -22.9262301 -16.7286110  -6.9286110  -6.4262301
##          43          44          45          46          47          48
##  -9.3872897 -16.3896707 -13.2872897 -11.1896707  -9.5872897  -5.2896707
##          49          50          51          52          53          54
##   1.6127103   4.5103293  -1.7872897 -12.5896707  13.3127103  -7.2896707
##          55          56          57          58          59          60
##   8.9103293  12.1127103 -14.4550468 -35.8574277  -0.8550468  -7.4574277
##          61          62          63          64          65          66
##  42.2449532  34.6425723  -3.9550468  29.0425723  30.5449532  27.0425723
```

```
##          67          68          69          70          71          72
## -39.1550468 -41.2574277  13.8425723 -19.9550468  -2.3471945  12.6504246
##          73          74          75          76          77          78
## -13.7471945  23.5504246   4.0528055   9.9504246  51.3528055  14.7504246
##          79          80          81          82          83          84
##   4.5528055 -19.6495754  -9.4471945 -18.1495754 -15.0495754  -2.8471945
```

```
m2 <- lmer(frequency ~ gender + attitude + gender*attitude+ (1|subject),
REML = F, data = data)
summary(m2)
```

```
## Linear mixed model fit by maximum likelihood  ['lmerMod']
## Formula: frequency ~ gender + attitude + gender * attitude + (1 | subject)
##    Data: data
##
##      AIC      BIC   logLik deviance df.resid
##    826.3    840.8   -407.1    814.3       78
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.2856 -0.5246 -0.1719  0.4929  3.2294
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  subject  (Intercept) 380.4    19.50
##  Residual             822.1    28.67
## Number of obs: 84, groups:  subject, 6
##
## Fixed effects:
##                     Estimate Std. Error t value
## (Intercept)          260.686     12.883  20.235
## genderM             -116.195     18.219  -6.378
## attitudepol          -27.400      8.848  -3.097
## genderM:attitudepol   14.795     12.514   1.182
##
## Correlation of Fixed Effects:
##             (Intr) gendrM atttdp
## genderM     -0.707
## attitudepol -0.343  0.243
## gndrM:tttdp  0.243 -0.343 -0.707
```

```
ranef(m2)
```

```
## $subject
##    (Intercept)
## F1  -12.950999
## F2    9.702421
## F3    3.248578
## M3   26.673406
## M4    4.521196
## M7  -31.194602
##
## with conditional variances for "subject"
```

```r
TS1 <- deviance(m1) - deviance(m2)
```

```
## Warning in deviance.merMod(m1): deviance() is deprecated for REML fits; use
## REMLcrit for the REML criterion or deviance(.,REML=FALSE) for deviance
## calculated at the REML fit
```

```r
p1 <- 1-pchisq(TS1, 1)
```

```r
m3 <- lmer(frequency ~ gender + attitude + (1+attitude|subject), data = data)
```

```
## boundary (singular) fit: see help('isSingular')
```

```r
summary(m3)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: frequency ~ gender + attitude + (1 + attitude | subject)
##    Data: data
##
## REML criterion at convergence: 796.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.3482 -0.5751 -0.2125  0.4770  3.2953
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  subject  (Intercept) 578.7865 24.0580
##           attitudepol   0.6511  0.8069  1.00
##  Residual             847.5471 29.1127
## Number of obs: 84, groups:  subject, 6
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)  257.588     15.040  17.127
## genderM     -110.000     20.933  -5.255
## attitudepol  -20.002      6.361  -3.144
##
## Correlation of Fixed Effects:
##             (Intr) gendrM
## genderM     -0.696
## attitudepol -0.177  0.000
## optimizer (nloptwrap) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```r
ranef(m3)
```

```
## $subject
##    (Intercept) attitudepol
## F1  -13.956088 -0.46807765
## F2    9.436867  0.31650606
```

```
## F3    2.744934  0.09206321
## M3   28.055212  0.94095263
## M4    5.301848  0.17782035
## M7  -31.582772 -1.05926460
##
## with conditional variances for "subject"
```

```
m4 <- lmer(frequency ~ gender + attitude + (1|subject)+(1|scenario), data = data)
summary(m4)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: frequency ~ gender + attitude + (1 | subject) + (1 | scenario)
##    Data: data
##
## REML criterion at convergence: 784.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.2690 -0.6331 -0.0878  0.5204  3.5326
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  scenario (Intercept) 224.5    14.98
##  subject  (Intercept) 613.2    24.76
##  Residual             637.8    25.25
## Number of obs: 84, groups:  scenario, 7; subject, 6
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)  256.987     16.101  15.961
## genderM     -108.798     20.956  -5.192
## attitudepol  -20.002      5.511  -3.630
##
## Correlation of Fixed Effects:
##             (Intr) gendrM
## genderM     -0.651
## attitudepol -0.171  0.000
```

```
ranef(m4)
```

```
## $scenario
##   (Intercept)
## 1  -13.485886
## 2    6.741980
## 3   11.600172
## 4   20.885315
## 5   -1.835659
## 6  -12.940097
## 7  -10.965825
##
## $subject
##    (Intercept)
## F1  -13.916125
```

```
## F2   10.425458
## F3    3.490667
## M3   28.661144
## M4    4.858122
## M7  -33.519266
##
## with conditional variances for "scenario" "subject"
```