Section 2.9

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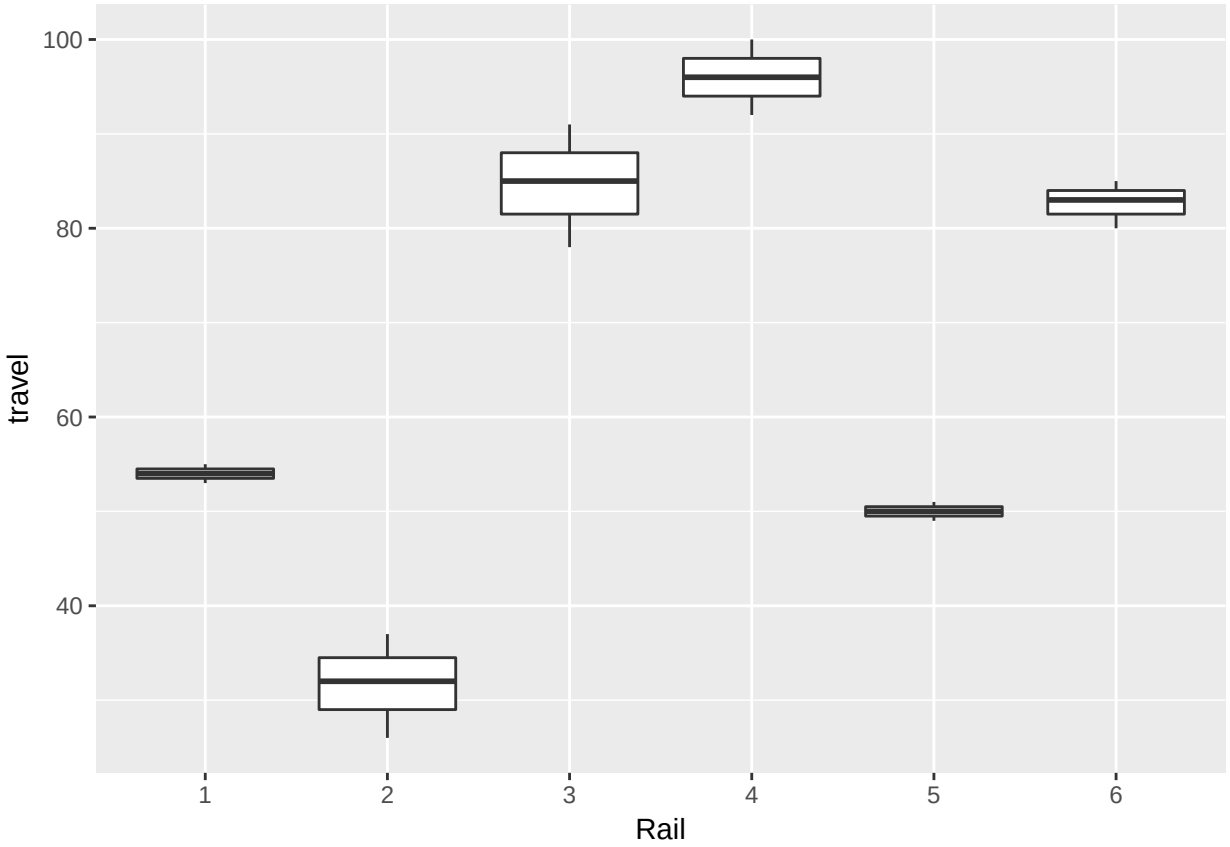
```
library(lme4)
```

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

```
load('MAS473.RData')
attach(raildata)
```

```
library(ggplot2)
qplot(Rail, travel, geom='boxplot')
```




```
fm1.ml<-lmer(travel~1+(1|Rail),raildata,REML=F)
fm1.reml<-lmer(travel~1+(1|Rail),raildata)

logLik(fm1.ml)
```

```
## 'log Lik.' -64.28002 (df=3)
```

```
logLik(fm1.reml)
```

```
## 'log Lik.' -61.0885 (df=3)
```

```
logLik(fm1.reml, REML=FALSE)
```

```
## 'log Lik.' -64.31256 (df=3)
```

not the same thing as gives log likelihood at REML parameter estimates

```
fm1<-lmer(travel~1+(1|Rail),raildata)
summary(fm1)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: travel ~ 1 + (1 | Rail)
##    Data: raildata
##
## REML criterion at convergence: 122.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -1.61883 -0.28218  0.03569  0.21956  1.61438
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  Rail     (Intercept) 615.31   24.805
##  Residual              16.17    4.021
## Number of obs: 18, groups:  Rail, 6
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)    66.50      10.17   6.538
```

```
lm1<-lm(travel~Rail, contrasts=list(Rail=contr.sum),raildata)
summary(lm1)
```

```
##
## Call:
## lm(formula = travel ~ Rail, data = raildata, contrasts = list(Rail = contr.sum))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6.6667 -1.0000  0.1667  1.0000  6.3333
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  66.5000     0.9477  70.169  < 2e-16 ***
## Rail1       -12.5000     2.1191  -5.899 7.27e-05 ***
## Rail2       -34.8333     2.1191 -16.438 1.36e-09 ***
## Rail3        18.1667     2.1191   8.573 1.84e-06 ***
## Rail4        29.5000     2.1191  13.921 9.10e-09 ***
## Rail5       -16.5000     2.1191  -7.786 4.96e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.021 on 12 degrees of freedom
## Multiple R-squared:  0.9796, Adjusted R-squared:  0.9711
## F-statistic: 115.2 on 5 and 12 DF,  p-value: 1.033e-09
```

```r
coef(lm1)[-1]
```

```
##     Rail1     Rail2     Rail3     Rail4     Rail5
## -12.50000 -34.83333  18.16667  29.50000 -16.50000
```

```r
sum(-coef(lm1)[-1])
```

```
## [1] 16.16667
```

```r
coef(lm1)
```

```
## (Intercept)       Rail1       Rail2       Rail3       Rail4       Rail5
##    66.50000   -12.50000   -34.83333    18.16667    29.50000   -16.50000
```

```r
sum(-coef(lm1)[-1]) # alpha_6
```

```
## [1] 16.16667
```

```r
ranef(fm1.reml)
```

```
## $Rail
##   (Intercept)
## 1   -12.39148
## 2   -34.53091
## 3    18.00894
## 4    29.24388
## 5   -16.35675
## 6    16.02631
```

```r
x <- ranef(fm1.reml)
sum(x$Rail)
```

```
## [1] -1.034373e-11
```

estimate of beta for both models

```r
mean(travel)
```

```
## [1] 66.5
```

```r
sqrt(4.021^2/18)
```

```
## [1] 0.9477588
```

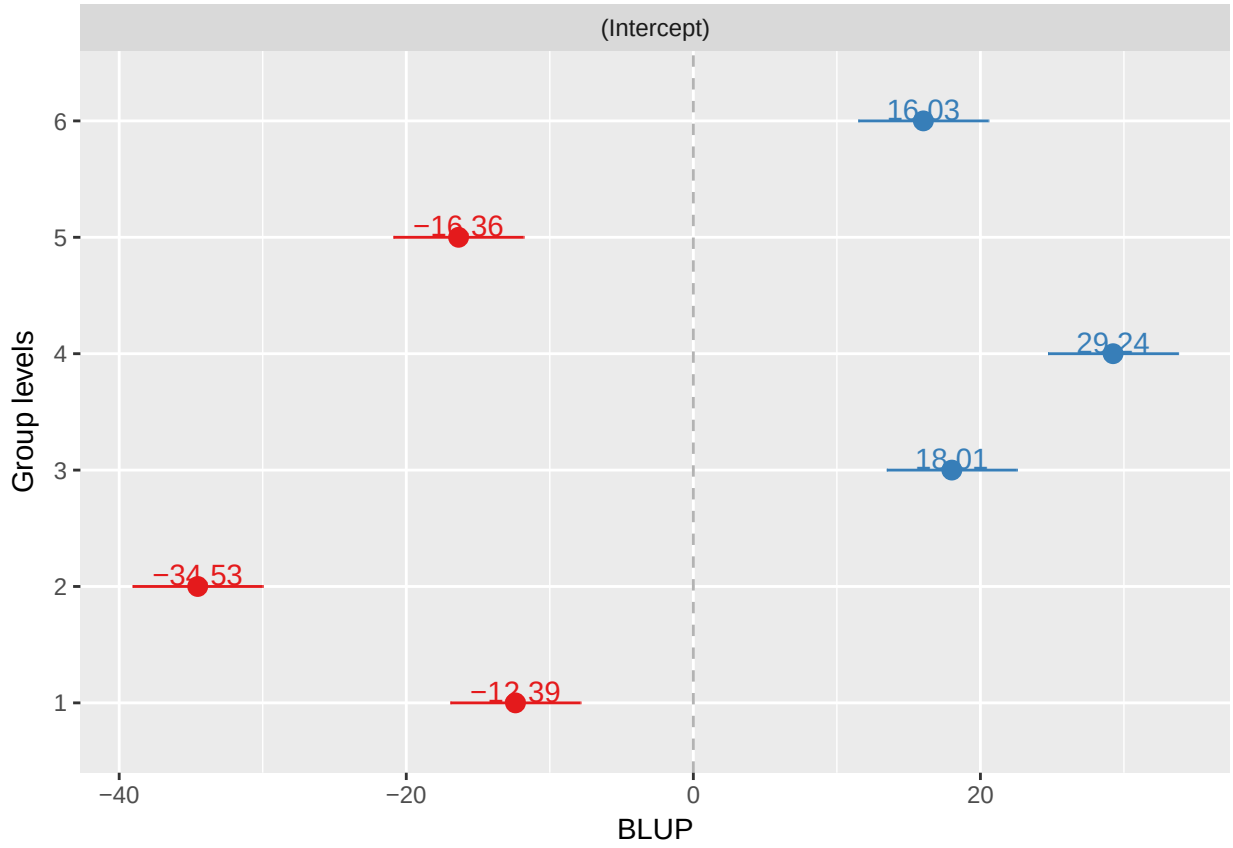
```r
sqrt(1/18*(3*615.31 + 16.17))
```

```
## [1] 10.17104
```

sjPlot library

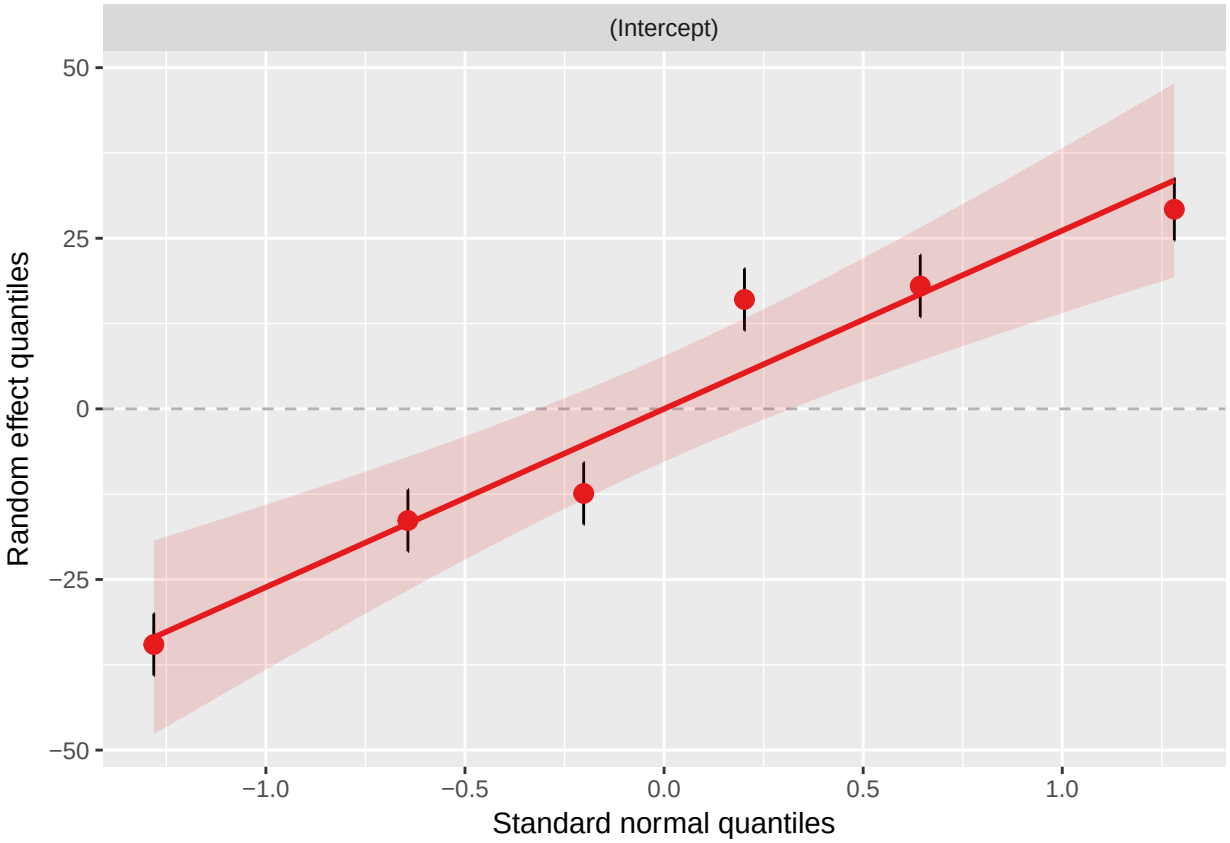
```r
library(sjPlot)
sjp.lmer(fm1,sort.coef=T)
```

```
## Plotting random effects...
```




```
#sjp.lmer(fm1, type='fe')
sjp.lmer(fm1, type='re.qq')
```

```
## Testing for normal distribution. Dots should be plotted along the line.
```


(Intercept)
50
25
0
−25
−50
Random effect quantiles
−1.0
−0.5
0.0
0.5
1.0
Standard normal quantiles