# Comments to the example

## The dataset

The example dataset is given in the following table. It comprises yields (Y) from an RCB experiment with three blocks and four treatments.

|  |  |  |
| --- | --- | --- |
| Block | Treatment | Y |
| 1 | 1 | 104 |
| 1 | 2 | 106 |
| 1 | 3 | 109 |
| 1 | 4 | 111 |
| 2 | 1 | 121 |
| 2 | 2 | 128 |
| 2 | 3 | 132 |
| 2 | 4 | 130 |
| 3 | 1 | 88 |
| 3 | 2 | 89 |
| 3 | 3 | 92 |
| 3 | 4 | 95 |

## The R script

R is a free software environment for statistical computing and graphics that can be downloaded from <http://www.r-project.org/>. Within R, open the script Example.R. For this script to work, the package lme4 must be downloaded from the Internet. This can be done through selecting Install Package from the Packages menu in RGui, or by writing install.packages(“lme4”) in the R Console window. Select a location close to you from the list of Comprehensive R Archive Network (CRAN) mirrors and download the package lme4. When the R editor window is active, run the script through selecting Run all from the Edit menu, or through pressing CTRL+A followed by CTRL+R.

Using R version 2.14.1, the code summary(Model) gives the following output:

Random effects:

Groups Name Variance Std.Dev.

factor(Treatment) (Intercept) 11.0556 3.3250

Residual 3.1389 1.7717

From the above output, the treatment effects variance, ,was estimated to be 11.0556, and the error variance, ,was estimated to be 3.1389. Using Eq. (6), the degrees of freedom was estimated to be 7.163406. Using Eq. (5), the (unadjusted) standard error was estimated to be 1.382632, whereas using Eq. 8, the Kenward and Roger adjusted standard error was estimated to be 1.507817. The treatment means were 104.3333, 107.6667, 111.0000, and 112.0000, for Treatments 1–4, respectively. The EBLUP of the difference between the effects of Treatments 1 and 2 was -3.045142. Using the Satterthwaite method, the 0.95 prediction interval for this prediction was (−6.29949 , 0.2092063), whereas using the Kenward and Rorger method, this prediction interval was (−6.594141 , 0.5038582). The R script provides a Bayesian 0.95 credible interval, which is based on sampling from a posterior distribution. The interval changes slightly each time the script is run. Note that the Bayesian 0.95 credible intervals provided by the R function mcmcsamp are not identical to the Bayesian 0.95 credible intervals provided by the SAS procedure mixed, which were investigated in the article.

## The SAS program

SAS version 9.2 ([www.sas.com](http://www.sas.com)) gives the following output:

Covariance Parameter

Estimates

Cov Parm Estimate

Treatment 11.0556

Residual 3.1389

Estimates

Standard

Label Estimate Error DF t Value Pr > |t| Alpha

Treatment 2 - Treatment 1 -3.0451 1.3826 7.16 -2.20 0.0626 0.05

Estimates

Label Lower Upper

Treatment 2 - Treatment 1 -6.2995 0.2092

From this output, the treatment effects variance, ,was estimated to be 11.0556, and the error variance, ,was estimated to be 3.1389. The difference between the effects of Treatments 1 and 2 was predicted to −3.0451, with standard error 1.3826, degrees of freedom 7.16, and 0.95 prediction interval (−6.2995 , 0.2092). These results were obtained using the Satterthwaite method. If “ddfm = kr” is substituted for “ddfm = Sat” in the SAS program code, the following results are obtained:

Estimates

Standard

Label Estimate Error DF t Value Pr > |t| Alpha

Treatment 2 - Treatment 1 -3.0451 1.5078 7.16 -2.02 0.0823 0.05

Estimates

Label Lower Upper

Treatment 2 - Treatment 1 -6.5941 0.5039

According to this output, using the Kenward and Roger method, the standard error was estimated to be 1.5078, and the 0.95 prediction interval for the difference between the effects of Treatments 1 and 2 was (−6.6941 , 0.5039).

Due to sampling, the Bayesian method gives slightly varying 0.95 credible intervals each time the program is run. Predictions and 0.95 credible intervals were provided by the univariate procedure. The Bayesian prediction, of the difference between the effects of Treatments 1 and 2, that was studied in the article is the mean given in the Basic Statistical Measures table. The calculated CoverageInterval dataset contains this mean and the 0.95 Bayesian credible interval.