DATA621 Extended LMR Ex 9.1

Chun Yip

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R Markdown

The ratdrink data consist of five weekly measurements of body weight for 27 rats. The first 10 rats are on a control treatment while seven rats have thyroxine added to their drinking water. Ten rats have thiouracil added to their water. Build a model for the rat weights that shows the effect of the treatment.

```
data(ratdrink, package="faraway")
head(ratdrink)
```

```
##    wt weeks subject   treat
## 1  57     0       1 control
## 2  86     1       1 control
## 3 114     2       1 control
## 4 139     3       1 control
## 5 172     4       1 control
## 6  60     0       2 control
```

```
summary(ratdrink)
```

```
##        wt            weeks      subject           treat
##  Min.   : 46.0   Min.   :0   1      :  5   control   :50
##  1st Qu.: 71.0   1st Qu.:1   2      :  5   thiouracil:50
##  Median :100.0   Median :2   3      :  5   thyroxine :35
##  Mean   :100.8   Mean   :2   4      :  5
##  3rd Qu.:122.5   3rd Qu.:3   5      :  5
##  Max.   :189.0   Max.   :4   6      :  5
##                              (Other):105
```

```
lmod1.random<-lm(log(wt)~treat, ratdrink)
lmod1.fixed<-lm(log(wt)~treat+subject+weeks, ratdrink)
summary(lmod1.random)
```

```
##
## Call:
## lm(formula = log(wt) ~ treat, data = ratdrink)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.75917 -0.31987  0.06269  0.30599  0.65048
```

```
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      4.587814   0.052018  88.197   <2e-16 ***
## treatthiouracil -0.110491   0.073565  -1.502    0.135
## treatthyroxine   0.003456   0.081064   0.043    0.966
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3678 on 132 degrees of freedom
## Multiple R-squared:  0.02161,    Adjusted R-squared:  0.006791
## F-statistic: 1.458 on 2 and 132 DF,  p-value: 0.2364
```

```
summary(lmod1.fixed)
```

```
##
## Call:
## lm(formula = log(wt) ~ treat + subject + weeks, data = ratdrink)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.25471 -0.05019  0.01400  0.06527  0.18576
##
## Coefficients: (2 not defined because of singularities)
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      4.176830   0.044782  93.271  < 2e-16 ***
## treatthiouracil -0.226312   0.061108  -3.703 0.000338 ***
## treatthyroxine  -0.078590   0.061108  -1.286 0.201191
## subject2         0.056664   0.061108   0.927 0.355871
## subject3        -0.024163   0.061108  -0.395 0.693320
## subject4        -0.130841   0.061108  -2.141 0.034533 *
## subject5        -0.087661   0.061108  -1.435 0.154340
## subject6        -0.141564   0.061108  -2.317 0.022429 *
## subject7        -0.185705   0.061108  -3.039 0.002984 **
## subject8        -0.007717   0.061108  -0.126 0.899743
## subject9        -0.211820   0.061108  -3.466 0.000761 ***
## subject10       -0.020188   0.061108  -0.330 0.741765
## subject11        0.115093   0.061108   1.883 0.062356 .
## subject12       -0.108682   0.061108  -1.779 0.078159 .
## subject13        0.072276   0.061108   1.183 0.239525
## subject14        0.104905   0.061108   1.717 0.088925 .
## subject15       -0.054177   0.061108  -0.887 0.377298
## subject16       -0.082194   0.061108  -1.345 0.181450
## subject17              NA         NA      NA       NA
## subject18        0.143973   0.061108   2.356 0.020292 *
## subject19        0.080846   0.061108   1.323 0.188656
## subject20        0.062938   0.061108   1.030 0.305355
## subject21        0.097918   0.061108   1.602 0.112021
## subject22        0.086851   0.061108   1.421 0.158147
## subject23       -0.005722   0.061108  -0.094 0.925571
## subject24        0.013758   0.061108   0.225 0.822295
## subject25        0.067675   0.061108   1.107 0.270576
## subject26       -0.143029   0.061108  -2.341 0.021107 *
## subject27              NA         NA      NA       NA
```

```
## weeks            0.243142   0.005880  41.350  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.09662 on 107 degrees of freedom
## Multiple R-squared:  0.9453, Adjusted R-squared:  0.9315
## F-statistic: 68.45 on 27 and 107 DF,  p-value: < 2.2e-16
```

For some reasons, it takes a long time to run the plm function to analyse the fix effect.The model with fixed effect has a much better fit and R-squared than the random effect.

```
step(lmod1.fixed)
```

```
## Start:  AIC=-606.36
## log(wt) ~ treat + subject + weeks
##
##
## Step:  AIC=-606.36
## log(wt) ~ subject + weeks
##
##           Df Sum of Sq     RSS     AIC
## <none>                  0.9989 -606.36
## - subject 26    1.2926  2.2915 -546.27
## - weeks    1   15.9618 16.9607 -226.04

##
## Call:
## lm(formula = log(wt) ~ subject + weeks, data = ratdrink)
##
## Coefficients:
## (Intercept)     subject2     subject3     subject4     subject5     subject6
##    4.176830     0.056664    -0.024163    -0.130841    -0.087661    -0.141564
##    subject7     subject8     subject9    subject10    subject11    subject12
##   -0.185705    -0.007717    -0.211820    -0.020188     0.036503    -0.187272
##   subject13    subject14    subject15    subject16    subject17    subject18
##   -0.006314     0.026315    -0.132766    -0.160784    -0.078590    -0.082338
##   subject19    subject20    subject21    subject22    subject23    subject24
##   -0.145466    -0.163373    -0.128394    -0.139461    -0.232034    -0.212554
##   subject25    subject26    subject27        weeks
##   -0.158637    -0.369341    -0.226312     0.243142
```

```
lmod2.fixed<-lm(log(wt)~treat+weeks, ratdrink)
summary(lmod2.fixed)
```

```
##
## Call:
## lm(formula = log(wt) ~ treat + weeks, data = ratdrink)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.290776 -0.086869 -0.007186  0.094524  0.243156
##
```

```
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)      4.101530   0.022453 182.671  < 2e-16 ***
## treatthiouracil -0.110491   0.024067  -4.591 1.02e-05 ***
## treatthyroxine   0.003456   0.026521   0.130    0.897
## weeks            0.243142   0.007323  33.201  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1203 on 131 degrees of freedom
## Multiple R-squared:  0.8961, Adjusted R-squared:  0.8937
## F-statistic: 376.5 on 3 and 131 DF,  p-value: < 2.2e-16
```

It is interesting to find out that treat was removed from the step function. The subject was removed for lmod2.fixed, but the R-square decreases. As such, the model should be lmod1.fixed.