STAT3012 Applied Linear Models

Computer Exercise week 11

We are going to analyse three datasets in the same way. The first two are from this week’s tutorial:

- **latsq** (tutorial question 1);
- **ratskin** (tutorial question 2);
- **fert.unif**: data from a uniformity trial whereby 8 different fertiliser treatments were applied to plots arranged in blocks of size 4, according to an incomplete block design. The yield from the previous year was recorded for each plot and used as a covariate.

1. Fit three different linear models using `lm()`:
   (a) one only fitting treatments, called `fit.trt`
   (b) one only fitting the covariates, called `fit.X`
   (c) one fitting both treatments and covariates called `fit.both`

2. Using `anova()` perform the general $F$-test for testing for differences between treatments (hint: compare the residual sums of squares from an appropriate smaller and larger model).

3. Obtain the unscaled covariance matrix $V_{trt}$ for the model only fitting treatments (hint: use `summary()`).

4. Obtain the unscaled covariance matrix for the treatment effects in the full model $V_{both}$, and compare it to the matrix obtained in the previous part. Does the design have one-way structure? Is it balanced? Is it orthogonal? Explain.

5. Extract the treatment effects from the vector `fit.both$coef` and form a matrix of pairwise differences using `outer()`, and by dividing by appropriate standard error(s) form $t$-statistics of all pairwise comparisons not already presented in `summary(fit.both)`. Compute a corresponding matrix of appropriate adjusted p-values for each. The smallest pairwise p-value is that of the Tukey test of no treatment effect.