5.11 Exercises

1. Carry out the sampling experiment described in Section 5.3 to partition the variability in paper helicopter flight times.
   (a) Read your data into R and estimate the variance components using the method of moments.
   (b) Using the `lmer` function, estimate the variance components using the REML method.
   (c) Using the formulas in Table 5.3, calculate 90% confidence intervals for the two variance components.
   (d) Write your conclusions. What should you use as the experimental unit in future studies to optimize flight time?
2. Read the data from Table 5.2 into R and
   (a) Calculate the ANOVA sums of squares and mean squares used in calculating the confidence limits in Section 5.4.2.
   (b) Calculate and compare the method of moments and REML estimates of the variance components.
3. Using the mean squares and expected mean squares from the gage R&R study presented in Section 5.5, use the `vci` function in the `daewr` package to compute a 90% confidence interval on the variance component for the interaction of operator and part.
4. Plan a sampling experiment to partition the source of variability in auto gas mileage in your community between drivers, cars, and replicates.
   (a) Describe how you would plan the study if drivers and cars were crossed factors.
   (b) Describe how you would plan the study if drivers were nested within cars.
   (c) Following the example in Section 5.4.4, determine the number of degrees of freedom you would need for the error or replicate term in your model if you desire the width of the confidence interval on the variance component for replicate to be 75% of σ^2.
5. Consider the data in Table 5.10.
   (a) Enter the data into R and estimate the variance components σ_a^2, σ_b^2, σ_c^2, and σ^2 using the method of moments and REML.
   (b) What are the major source or sources of variability?
   (c) Is there any difference between the method of moments or REML estimators of the variance components?
6. Consider the data (Anderson and McLean, 1974) in the following table to come from a sampling study to determine the source of variability in the average amount spent on health care per year in thousands of dollars. Towns are nested within state and households are nested within town.