Solution to Exercise 13.4 (Version 1, 1/1/16)

from Statistical Methods in Biology: Design & Analysis of Experiments and Regression (2014) S.J. Welham, S.A. Gezan, S.J. Clark & A. Mead. Chapman & Hall/CRC Press, Boca Raton, Florida. ISBN: 978-1-4398-0878-8

Exercise 13.4

In Exercise 12.2, you fitted a SLR to the log-transformed wet weight of flying insects collected over 30 years. Re-analyse these data without transformation, and use diagnostic plots to assess whether the model assumptions are better met on the untransformed or log scale. Check whether there is any sign of correlation in the errors between successive measurements on your chosen scale. (We re-visit these data in Exercise 15.1.)

Solution 13.4

Figure S13.4.1 shows composite residual plots from the SLR on the untransformed and log scales, and Figure S13.4.2 shows the fitted model on both scales (see Exercise 12.2 for details of model). There is not a lot to choose between the two sets of residual plots, although there is one outlying point on the original scale, and the histogram of residuals is more symmetric and normal plot is closer to a straight line for the log transformation. Overall, we slightly prefer the analysis with the log transformation. A wider experience of this type of data suggests that the log-transformation is more likely to give variance homogeneity, and so we will keep the log-transformation.

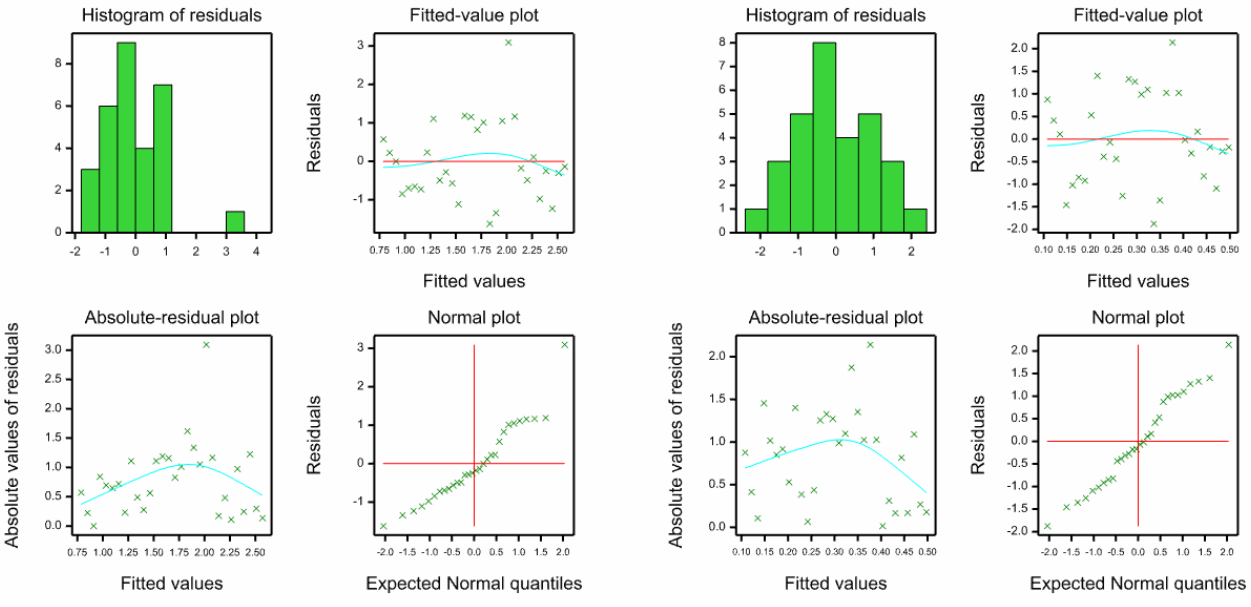

Figure S13.4.1. Composite residual plots based on standardized residuals from SLR of wet weights (a) untransformed; (b) with log transformation (with offset of 0.5).

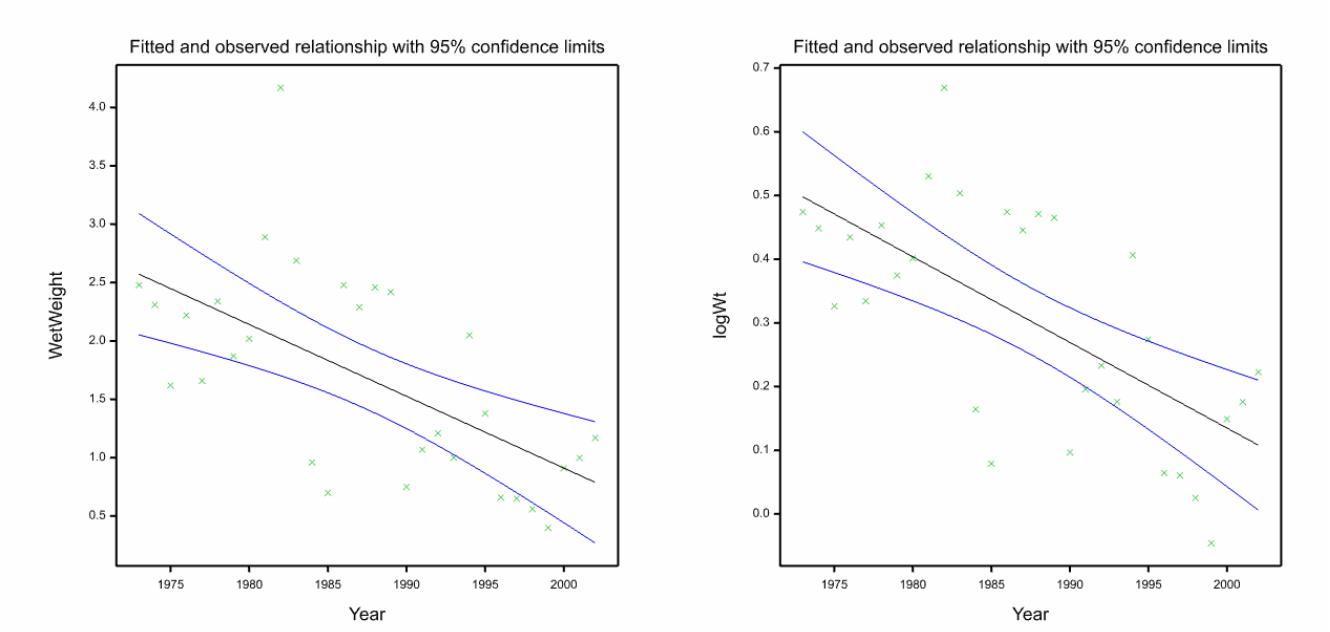

Figure S13.4.2. Fitted SLR with 95% CIs and observed data (a) untransformed; (b) with log transformation (with offset 0.5).

To investigate whether there is any evidence of correlation over time, we will examine the residuals from the SLR with log transformation further; we do an index plot of the residuals against the *Year* explanatory variable (Figure S13.4.3a), and plot the residual for each year against that for the previous year (Figure S13.4.3b).

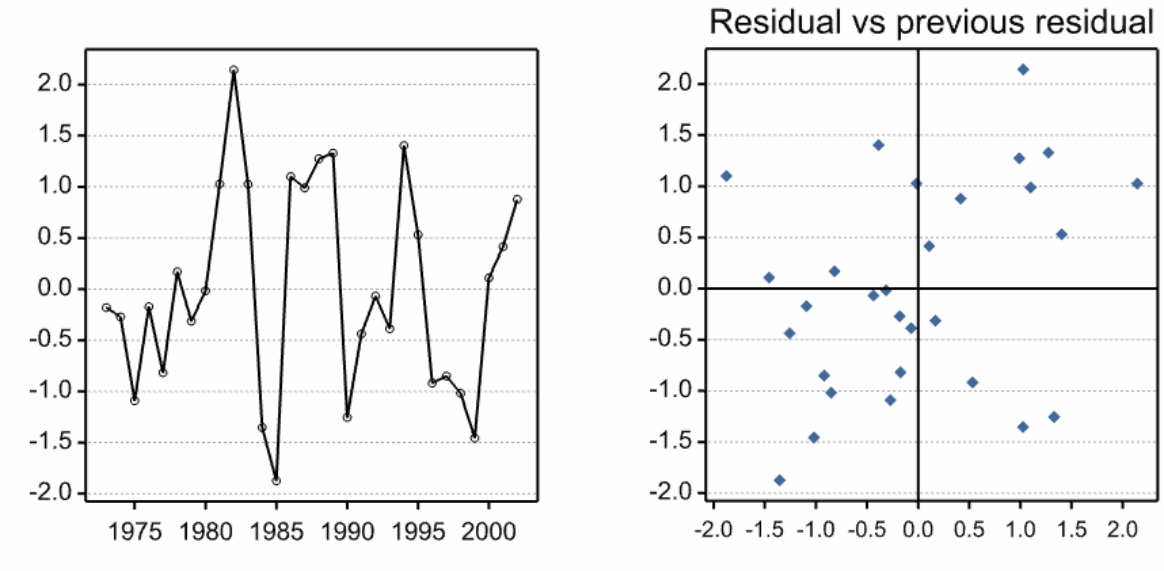

Figure S13.4.3. (a) Index plot of residuals against year; (b) residual from each year plotted against residual from previous year.

There is a suggestion here of positive correlation: there are a few runs of similar values and seems to be a slight preponderance of values in the positive-positive and negative-negative quadrants of the second plot. The correlation between each residual and that from the previous year is 0.34, supporting this hypothesis. We cannot investigate or take account of this positive correlation within linear regression, but we could do this within the context of linear mixed models.