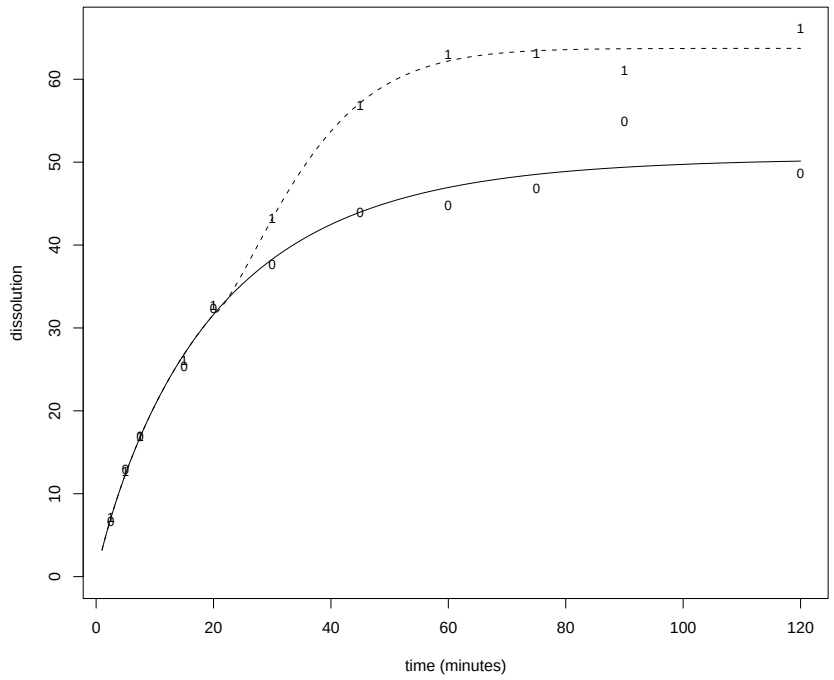
ST 762, HOMEWORK 3 SOLUTIONS, FALL 2009

1. (a) Here is the plot – we've also superimposed the GLS-PL fit, as requested in part (g), where a different line type is used for each vibration condition.

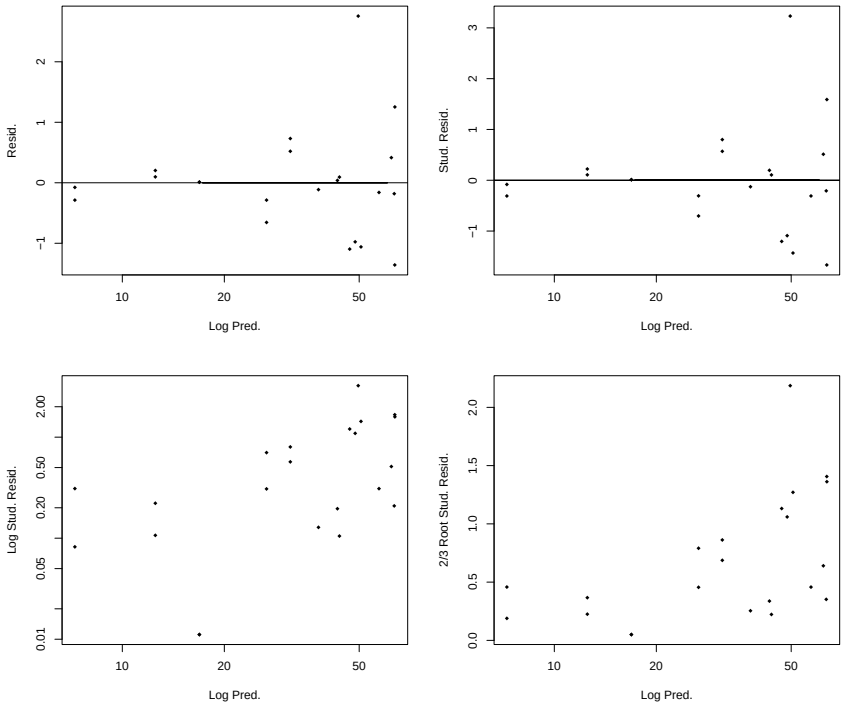


(b)–(e) See the programs and output. The results are similar across all methods, both for β and θ. The estimates of σ are more disparate: 0.027 for PL, 0.036 for identity, 0.055 for log, and 0.024 for normal theory maximum likelihood. Of course, we don't have standard errors associated with these, so we can't really say whether or not this reflects differences among the procedure. For (d), the estimate of σ above is obtained using the "usual" (quadratic) estimator; alternatively, one might try estimating σ as $\exp(\widehat{\eta})$ from page 136 to obtain $\exp(-3.925) = 0.020$); of course, this estimator does not estimate σ but instead σ times a multiplicative constant, as $\eta = \log \sigma + E(\log |\epsilon_j||\boldsymbol{x}_j)$. The disparity in "usual" σ estimates is probably to some extent attributable to the slight differences in the corresponding estimates of θ.

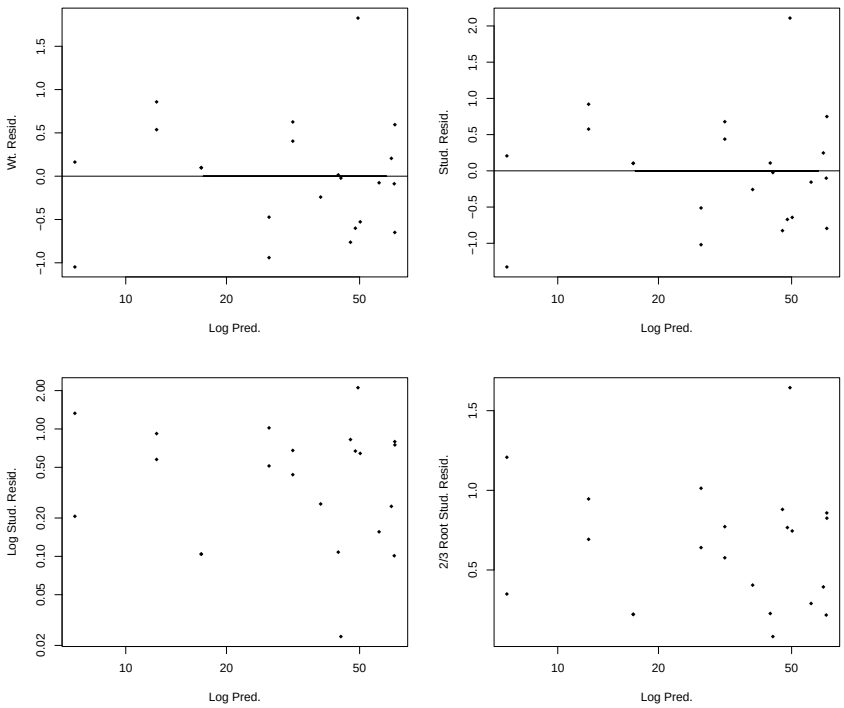
(f) The point estimates for θ are all in the ballpark of 0.9 to 1.1, suggesting that variance is almost certainly not constant (the pattern may be closer to that of constant coefficient of variation).

(g) See above; the model seems to describe the pattern pretty well.

2. Please see the program and output for (a)–(e). Here are the OLS residual plots:



and the GLS-PL residual plots



The OLS residual plots (b) contain fairly persuasive evidence of nonconstant variance. The

plots of GLS-PL residuals in (c) suggest that incorporating the variance model has taken appropriate account of the nonconstant variance pattern. In (d), the standard errors calculated here are identical to those from `nls()`, which is reassuring! The robust SEs in (e), on the other hand, are fairly different from the model-based ones for several of the components of $\boldsymbol{\beta}$. This could be a function of the smallish sample size or an ill-fitting variance model; it is difficult to say.