Answer Key #2

1. [From Wool 8.7] Consider a model at the employee level.

*yi,e = βo + β1xi,e,1+ . . . . + βkxi,e,k+ fi + vi,e*

where the unobserved variable *fi* is a “firm effect” to each employee *e* at a given firm *i*. The error term *vi,e* is an individual specific error term—that is, it is specific to each individual at each firm. The composite error is  *uie=fi + vi,e* (as in equation 8.28).

1. Assume that *Var(fi) = * and *Var(vi,e) = *and *fi* and *vi,e* are uncorrelated. Show that Var(*uie*) = *+*.

*This follows from the simple fact that, for uncorrelated random variables, the variance of the sum is the sum of the variances: .*

1. Now suppose that for e≠g (that is, we are looking at two different employees), *vi,e* and *vi,g* are uncorrelated. Show that Cov(*uie, uig*)= *.*

*We compute the covariance between any two of the composite errors as*

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*where we use the fact that the covariance of a random variable with itself is its variance and the assumptions that  are pairwise uncorrelated.*

1. Let --that is the average composite error within a firm with mi employees. Show that 

*This is most easily solved by writing*

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*Now, by assumption, fi is uncorrelated with each term in the last sum; therefore, fi is uncorrelated with . It follows that*

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*where we use the fact that the variance of an average of mi uncorrelated random variables with common variance ( in this case) is simply the common variance divided by mi  – the usual formula for a sample average from a random sample.*

1. Discuss the relevance of part (iii) for WLS estimation using data averaged at the firm level, where the weight used for observation i is the usual firm size.

*The standard weighting ignores the variance of the firm effect, . Thus, the (incorrect) weight function used is. A valid weighting function is obtained by writing the variance from (iii) as  But obtaining the proper weights requires us to know (or be able to estimate) the ratio . Estimation is possible, but we do not discuss that here. In any event, the usual weight is incorrect. When the mi are large or the ratio  is small – so that the firm effect is more important than the individual-specific effect – the correct weights are close to being constant. Thus, attaching large weights to large firms may be quite inappropriate.*

1. [Based on Wool C8.4] Use the data in VOTE1.RAW to estimate the following equation:

*See log file posted on website.*