

Stat 230, Spring 2016

Homework 4: GLS, correlated errors

All due Thursday 2/18/15 in by 11:55pm on bcourses.

Part 1: Problems from the book

Ch 5: A1, B2, submit answers on bcourses.

Ch 5: C1,3 read and understand. You'll also want to look over Ex. 1 and 2 in section 5.4, both discussed in lecture.

Part 2:

For this assignment, start with the template HW4.R and before you submit it, rename it to LastnameFirstnameHW4.R, like ObamaBarackHW4.R. Some of the explanation for what code to run is in that file. For the brief comments on results shown in plots, say whether the results seem to be biased, whether they should be biased, and comment on the variability of the estimates.

1. Generate correlated errors

- (a) The errors will be generated as in “Notes ii)” at the end of Ch 4 Disc #17, with $n = 100$ and $r = 0.05$ (same for all r_{ij}). Thus you will construct the matrix G with diagonal entries of 1 and 0.05 everywhere else (as done in lecture code for $n = 10$).
- (b) You will simulate 1000 replications of the errors (each one 100x1) by multiplying the cholesky decomposition of this matrix by a vector of iid standard normal errors to get a vector of correlated errors. Assign them to a 100x1000 data frame called `epsilons`.
- (c) Let $S_n = \sum_{i=1}^{100} \epsilon_i$, so you have 1000 replications (realizations) of the random variable S_n . Find the empirical values of σ^2 , r , and $var(S_n)$. Do they follow the relationship in Ch 4 Disc #17a)?
- (d) Get the true $var(S_n)$ based on the how they were generated (using Ch 4 Disc #17) using the true values for σ^2 and r from G .

2. OLS

- (a) Construct X a 100x1000 matrix of standard normals (code given in HW4.R).
- (b) Do OLS, estimating β 1000 times.
- (c) Make histogram of $\hat{\beta}$ s including a vertical line for the true β . Comment briefly on how well OLS does here. Note that if this were real data, we would see only 100 observations, we wouldn't get to do this 1000 times.

3. One Step GLS

- (a) Under the assumption that the errors have the same variance and common correlation r_{ij} (ie G is constant along the diagonal and constant everywhere else), do one step GLS, estimate β 1000 times, and make the same histogram as you did for OLS. Comment briefly.
- (b) Make a histogram of the 1000 \hat{r} s with a vertical line through r . Comment briefly.
- (c) Make a histogram of the 1000 $\hat{\sigma}$ s with a vertical line through σ . Comment briefly.

4. Five Step GLS

Do 5 steps of GLS, make a plot that has the step number on the x axis (include OLS as step zero), and for each step make a boxplot of the $\hat{\beta}$ s. Thus the boxplots should be side by side all on one plot, and put a horizontal line through the true value of β . Also make the same 3 histograms you made for One Step GLS for the final (Fifth Step) estimates. Comment as you did for One Step GLS. Were five steps enough?