Answer key Pset IV

Variable	Coefficient	OLS_SE	CF_SE	Correct_SE	Bootstrap SE
d	2.9657	1.1223	1.1544	1.1463	1.3228
BK	-2.051	1.1222	1.1543	1.1477	1.484
KFC	-1.5614	1.3669	1.406	1.3991	1.2727
Roys	-4.3139	1.2869	1.3237	1.3172	1.3227
Wendys	-2.1109	1.4711	1.5132	1.4968	1.6937

a. The table above contains the results from the estimation using the following model:

(Eqn 1) $$\Delta y_i = \beta d_i + \gamma_1 BK_i + \gamma_2 KFC_i + \gamma_3 ROYS_i + \gamma_4 WEND_i + \eta_{c_i d_i} + \varepsilon_i$$

The first and the second columns correspond to the estimates and standard errors using an OLS standard model without correcting for cluster variance. Here you can compare this to the estimates obtained from the following estimation in lecture note 11 (pp. 12):

(Eqn 2) $$\Delta y_i = -2.11 + 2.97 d_i + .060 BK_i + .55 KFC_i - 2.20 ROYS_i$$

From these result you can realize that Wendys, which was the omitted term in the above equation (i.e. used as a reference) has the same coefficient as the constant term in equation 2. And the rest of the estimates from the table above are equal to the constant term in equation 2 (-2.11) plus their corresponding coefficient in equation 2.

For example, the coefficient of BK in the above table (-2.051) is equal to the constant term plus the BK coefficient in equation 2 (-2.11+0.060)

b. We have eight clusters and the size in each cluster is illustrated by the following table:

	d=0	d=1
BK	34	129
KFC	12	68
Roys	17	78
Wendys	13	40

σ2_ε	76.5812
σ2_η	0.0929
σ2	76.6742
ρ	0.0012

c. The correction factor is equal to 1.058 and is based on an average cluster size equal to 48.875

In the above table the SEs calculated with the correction factor are showed in the third column.

d. Similarly, the above table shows the correct SEs. To see the details for the calculations see the related Matlab m-file.

e. The next table contains the result from running the model including the interaction terms. It is important to note that one interaction has to be left out of the regression, otherwise there would be multicollinearity in the model, where d would be equal to the sum of the four interaction terms.

In this case, by adding the interaction terms we are controlling for differences among the different clusters, this means that we cannot decompose the error term in an individual term and a cluster specific term, since all the cluster specific unobservables are absorbed by the interaction terms. Hence, in this case one would report the normal OLS SEs.

Model:

$$\Delta y_i = \beta d_i + \gamma_1 BK_i + \gamma_2 KFC_i + \gamma_3 ROYS_i + \gamma_4 WEND_i + \lambda_1 d_i BK_i + \lambda_2 d_i KFC_i + \lambda_3 d_i ROYS_i + \varepsilon_i$$

	Coefficient	OLS_SE
d	3.5832	2.7938
BK	-3.3676	1.5008
KFC	2.0417	2.5262
Roys	-3.8676	2.1224
Wendys	-2.5769	2.4271
d*BK	1.0461	3.2637
d*KFC	-4.8565	3.9132
d*Roys	-1.161	3.6458

f. Finally, the first table contains the results from running the non-parametric bootstrap with 10,000 repetitions.

Reported as the SEs is the standard deviation of the different values of the coefficients from the repetitions.