# Estimation Methods for Cluster Randomized Trials with Noncompliance[*]

Hyunseung Kang[†]        Luke Keele[‡]

September 28, 2017

## Research Question

Many educational evaluations occur in settings with randomized assignment at the cluster level and treatment noncompliance at the unit level. For example, classrooms might be assigned to treatment and control, but students may choose to not comply with their assigned treatment status. When noncompliance is present, investigators may choose to focus attention on either intention to treat effects or the causal effect among the units that comply. When analysts focus on effects among compliers, the instrumental variables framework can be used to evaluate identify causal effects. IV estimation methods for clustered treatment assignments, however, have seen little development in the statistics literature. We first review extant methods for IV estimates in clustered designs. The first method relies on cluster level summaries, and the second uses individual level data, but corrects variance estimates for clustering. The key limitation of both methods is that they rely on asymptotic approximations that depend on the number of clusters being large. Both methods also assume that treatment effects do not vary with clusters.

## Proposed Methods

We present two corrections for these problems. First, we develop a finite sample variance estimator for IV methods in clustered designs. We adapt finite sample corrections in the unclustered IV setting to applications with cluster level treatments. Next, we develop a nonparametric estimator that accounts for possible treatment effect heterogeneity that is correlated with cluster size. The method is based on a simple shrinkage estimator that places greater weight on clusters with smaller variances.

## Results

Using a series of simulations, we find that methods that rely on asymptotic approximations often perform well even when the number of clusters is small. Next, we apply these methods to data from the John Hopkins University Preventative Intervention Research Center's Family-School Partnership (FSP) intervention. The intervention in the study was designed by the investigator to improve academic achievement and reduce aggressive and shy behaviors in first grade students. The FSP intervention was randomly assigned at the classroom

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[†]Assistant Professor, University of Wisconsin, Madison, Email: hyunseung@stat.wisc.edu
[‡]Associate Professor, Georgetown University, Email: lk681@georgetown.edu

level. Out of 18 classrooms, 9 were assigned to the FSP intervention and 9 were assigned to control. For students in classrooms assigned to the control condition, no additional activities were assigned. For students in treated classrooms, educators requested that parents complete 66 take-home activities related to literacy and mathematics with their children. In the FSP intervention, compliance with the treatment assignment varied. In some classrooms, as many as 93% of the students complied with the treatment, while in one classroom only 6% of the students complied with their assigned treatment assignment. Here, we find that accounting for cluster level variation in the treatment effects is an important aspect of the analysis.