**Session 2 (10:30 – noon)**
**Small group exercise:**
**Principal stratification set up and defining estimands of interest**

In each of the three applications presented here, consider the principal stratification set up questions defined in the first session of today's workshop:

1. What is the treatment that was randomized?
2. What is the intermediate behavior of interest?
3. What are the strata?
4. What is / are the outcome(s) of interest?
5. In which strata is the treatment effect well defined?
6. What are the justifiable assumptions that can reasonably be applied to:
    a. reduce the number of strata, and/or;
    b. constrain the treatment effects within certain strata

    in order to make the problem more tractable?

**Application 1: Variation in the impact of Head Start by counterfactual setting**

In the Head Start Impact Study, in which the opportunity to enroll a child in Head Start was randomly offered to interested families, modest positive impacts of Head Start were observed on early academic measures, such as the Peabody Picture Vocabulary Test (PPVT), a continuous measure of receptive vocabulary. Both the treatment and control groups had a great deal of variation in the types of child care settings in which children participated: some children participated in Head Start, some enrolled in another (non-Head Start) center-based care setting, and still other children were cared for at home, primarily by a parent or relative.

Apply the principal stratification framework to the questions of whether and to what extent the effect of Head Start varies according to the care setting children would experience absent the Head Start offer. In which strata would you hypothesize that treatment effects would be largest? Why?

**Application 2: Impact of a scholarship offer on college quality**

Consider a hypothetical college access program that is oversubscribed and to which students can gain entry via lottery. Similar to programs offered by organizations like Bottom Line and OneGoal, the program provides one-on-one counseling to students from the end of their junior year of high school through the fall after high school graduation. Program staff members provide students with coaching related to SAT preparation and registration as well as all aspects of the college search and application process. The program also helps students manage post-graduation transition activities, such as accessing additional 11$^{th}$ hour financial aid to meet unmet need and arranging transportation to campus.

Consider a scenario in which this college access program, based on the associated lottery data, has been shown to have a positive and substantial impact on whether students successfully enroll in college in the fall after high school. Beyond understanding whether students enroll, program administrators are interested in understanding where students enroll. Specifically, they want to understand whether the "quality" of the college in which their students enroll is improved by the program.[1]

How would you use principal stratification to frame questions about the program's impact on the quality of the institutions in which students enroll? For which students is this question well defined? Use your principal stratification framework to explain why overall college "quality" might be lower in the treatment group than in the control group.

[1] While metrics for college quality are certainly debatable, for the present consider readily observable factors such as college type (e.g., two-year vs. four-year), degree attainment rates, per-student expenditures, institutional selectivity, and average student SAT/ACT scores.

**Application 3: Ninth grade on-track status as a precursor to timely high school completion**

Research in urban districts suggests that as many as 40 percent of students fail to get promoted from ninth to tenth grade on time, and fewer than 20 percent of those students recover from failure and go on to graduate from high school.[2] This descriptive evidence suggests that keeping students on-track through the end of ninth grade may be an important precursor to timely high school graduation. Small Schools of Choice (SSCs) were created in New York City in the early-to-mid 2000s, with special supports from the NYC Department of Education and philanthropic organizations, in order to create small, personalized, public high school learning environments available to students of all academic backgrounds within NYC. The complex process of school selection in NYC led to a series of naturally-occurring lotteries in the assignment of students to these SSCs.[3] Work led by Howard Bloom and Rebecca Unterman, both of MDRC, showed substantial positive impacts on the proportion of students who were on-track to graduate at the end of ninth grade as well as the proportion of students that complete high school on-time. Bloom and Unterman observed these impacts across a broad range of student subgroups. An important question is whether the impact of SSCs on four-year high school completion relates to (and potentially stems from) their impact on getting students to be "on-track" at the end of 9$^{th}$ grade (where students are either on-track or not, based on earning sufficient credits in required courses in the ninth grade).

How can you use principal stratification to frame your approach to this question? In which of your strata might you expect to see the largest impact on high school graduation? What pattern of stratum specific treatment effects would be consistent with the hypothesis that on-track status is an important precondition to timely high school completion?

[2] e.g., Kemple et al., 2005; Allensworth and Easton, 2005; Balfanz and Neild, 2007.
[3] Bloom & Unterman, 2014; Unterman, 2014.