# 11: Instrumental Variables and RDD Part 2

## Introduction

* In real-life, it’s rarely the case that there are no non-compliers in a RDD analysis.
* Can use instruments to estimate a discontinuity in this situation.
* Instruments can be used to help with all sorts of compliance issues.

## Treatment Effects and Compliance

* Compliance affects the types of effects we can estimate in a causal inference analysis.
* We use ATEs to estimate intervention effects because we can’t observe individual-level counterfactuals.
* Ideally wish to estimate a population-level effect, but that can be tricky to do. This means more often other causal effects such as ATT or CATE are estimated.
* In RDD, you estimate a local ATE as you’re only looking at the causal effect for individuals within a specified bandwidth. This means you can’t generalise to the broader population.
  + Often this can be okay, even when performing something like DiD.
* In addition, in IV and RDD analysis, you’re only estimating the effect for compliers.
* In causal inference, typically assume that defiers don’t exist or otherwise ignore them.
  + Fairly safe assumption.
* Those assigned to the treatment group and take it could be a complier OR always taker and can’t determine for sure.
* Those assigned to the treatment group and don’t take it are generally assumed to be a never-taker (in the world where defiers don’t exist).
* Those assigned to the control group and don’t take it are assumed to be compliers or never takers. Again, we don’t know for sure which they are.
* Those assigned to the control group and somehow get the treatment are assumed to be always takers (again in a world where defiers don’t exist).
* Want to analyse the compliers, but they’re always wrapped up together with another group.

### Intent to Treat (ITT)

* Analyses the effect of those assigned to treatment irrespective of what they actually end up doing, which removes the issue of compliers and always takers.
* However, doesn’t really get at the issue of whether the intervention had any effect/work.
* Can only say something about whether treatment assignment had any effect.

### Complier Average Causal Effect (CACE)

* A type of conditional ATE.
* Need to disentangle them from the always takers in the treatment group, which can be tricky (but not impossible).
* If you can’t read people’s minds, it doesn’t appear as though the intervention had any significant impact.
* The ITT effect is the combined effect of the compliers, always takers and never takers.
  + Weighted sum of the respective effects by the proportion of each group in the sample.
  + The goal is the , which means we somehow need to mathematically calculate or otherwise remove the other causal effects in the equation.
  + Perform some mathematical trickery to get to this i.e. the effect of the program should theoretically be 0 for always takers (because the difference between the treatment and control average will be essentially the same) and similarly for never takers.
  + The ITT and the proportion of compliers are both numbers that can be calculated from the existing data.

### Finding the ITT

* Fairly easy to accomplish.

### Finding

* Accomplished by finding , which relies on one crucial assumption: the proportion of always and never takers are the same across the treatment and control groups.
  + i.e. 50% of always takers are in the control group and 50% are in the treatment group.
  + Hence, because we know the proportion of always takers in the control group, we know what it is in the treatment group.
* Even though we don’t actually know who the always takers and never takers are, in aggregate, as long as making the required assumptions such as no defiers is reasonable, we can calculate the CACE.
* Can do this really fast using an instrument and 2SLS.
* Instruments automatically do the whole process for you because that’s actually how 2SLS works behind the scenes.

## Randomised Promotion

* Can also use instruments in non-conventional ways.
* Solution to programs with universal accessibility.
* Tricky to measure the causal effect of such programs due to selection bias and likely systematic differences between who opts-in and who doesn’t.
* Also can’t do a randomised control trial due to ethics.
* Encouragement doesn’t quite create true treatment and control trials as you can’t force people to comply with the encouragement.
* BUT, it doesn’t work if the encouragement is used as an instrument rather than directly as treatment/control assignment.
  + Hence, removes the endogenous part of the group assignment.
* It’s not weird, but it does work.
  + Relevant
  + Clear pathway to the result – encouragement increases the possibility of the individual doing that action.
  + Exogenous – get around that through the fact that encouragement is randomised.
* Also gets around the compliance issue.
  + Can’t find a population level treatment effect, but can find the effect of encouragement on the outcome.
* Still provides useful information about the effect on individuals who listen to policy/intervention incentives/direction.
* Unique and interesting way to analyse the effect of a program on individuals who would use the program without having to resort to a RCT.

## Fuzzy Regression Discontinuity

* Non-compliers mess up the discontinuity.
* Use an instrument to limit the effect at the cut-off to compliers.
* This instrument again won’t be weird and is just an indicator variable of what they were supposed to do i.e. TRUE if above the cut-off and FALSE if below the cut-off.