Terms:

Group k 🡪 Lambeth (the utility company that moved its pipe)

Group U 🡪 Southwark and Vauxhall (the utility company that didn’t move its pipe)

Pre 🡪 1849

Post 🡪 1854

Y (the outcome) is the observed cholera mortality

Y1 (potential outcome) is the potential cholera mortality for units that had their pipe moved

Y0 (potential outcome) is the potential cholera mortality for units had their pipe not been moved

Y is observed, but Y1, Y0 are not observed because they are “hypothetical states of the world”.

E[Y1k] 🡪 Average cholera mortality for Lambeth in a world where Lambeth moved its pipe

E[Y1U] 🡪 Average cholera mortality for Southwark and Vauxhall *had they* moved their pipe (even though they didn’t)

E[Y1k|Post] 🡪 Average cholera mortality for Lambeth (group k) in 1854 had Lambeth moved its pipe by 1854

E[Y0k|Post] 🡪 Average cholera mortality for Lambeth (group k) in 1854 had Lambeth *not moved* its pipe by 1854 (even though we know they actually did – this is purely counterfactual)

E[Y0k|Pre] 🡪 Average cholera mortality for Lambeth (group k) in 1849 had Lambeth not moved its pipe in 1849 (which they didn’t so this is observed in real data)

Average treatment effect on the treatment group (ATT) is:

E[Y1k|Post] – E[Y0k|Post]

The first number we can calculate with data bc by the switching equation E[Y1k|Post] is just E[Yk|Post] (ie cholera mortality for Lambeth in 1854). So Y=Y1 for group k in 1854. But we cannot calculate the second number in red. And that’s because the second number in red is **counterfactual**. In 1854, Y0 did not exist for group k. Because in 1854, D=1 and when D=1, we observed Y=Y1, not Y0. Y0 is counterfactual for Lambeth in 1854. Nevertheelss we can define the causal parameter regardless of whether we can measure it.

Bias terms 🡪 “non-parallel trends” is the *selection bias* term in the DiD equation. It’s just like selection bias from before, only now we won’t be depending on physical randomization to delete it. We will instead be HOPING that it’s zero, and try to find some evidence that supports that.

Non-parallel trends bias 🡪 E[Y0k|Post] – E[Y0k|Pre]. This is a counterfactual trend bc that first number cannot be caculated. You can’t calculate Y0k in the post period because in the post period there is only Y1k. Nevertheless, this is the trend that *would have happened* had Lambeth not moved its pip.

E[Y0U|Post] – E[Y0U|Pre]. And this is the “actual trend” for the comparison group. And if the actual trend for the comparison group is the same as the *counterfactual trend* for the treatment group, then there is no selection bais, and we don’t need randomization. We just need “parallel trends”.