

## Lecture 9 – Interrupted Time Series

### Intuition

The comparison in an interrupted time series is basically a before and after comparison. The counterfactual for treatment is the treated unit just before treatment occurs.

A (maybe not so) nice example is hitting your hand with a hammer. We all know this is painful because our finger was feeling fine and then suddenly, right when “treatment”/hitting ourselves with a hammer occurs our pain spikes.

Another way to discuss this is as a “difference” estimator where the difference is across time. This is in contrast to a differences in differences estimator.

### Benefits and Drawbacks

Interrupted time series is well suited for treatments that are expected to have an immediate impact. They are much less ideal for treatments that take a while to phase in. For instance, taking an anti-anxiety medication that takes some time to work would be difficult to evaluate using an interrupted time series design. You would compare how you are feeling before taking the medication (anxious) to how you feel the instant after you take the medicine. Most medicine of this type takes a while to become effective and so that comparison is likely to be no very useful.

You might say, well, just wait longer to make the comparison. The problem is that many things might have changed the longer you wait. For instance, perhaps you lose your job which increases your anxiety. This was probably unrelated to your taking anxiety medication but would affect your level of anxiety. If you do a “long” interrupted time series, any other changes that occur will be incorrectly attributed to treatment. A particular issue with this would be if there are trends in the outcome. Then the difference will pick up any treatment and the cumulative “effect” of the trend.

If people are aware of treatment occurring at some point that can invalidate an interrupted time series design. For instance, if I know treatment is coming I can adjust my behavior. If I know I will hit my hand with a hammer at 10:16 am, I can make sure to protect my hand/move my hand/something.

This phenomenon of changing before treatment has been called the “Ashenfelter Dip” after Orley Ashenfelter of Princeton. He noted that in job training programs income was falling before people entered which complicated estimating the effect of job training. This is not a case of people anticipating treatment, but rather choosing treatment because there was a pre existing trend in their outcome.