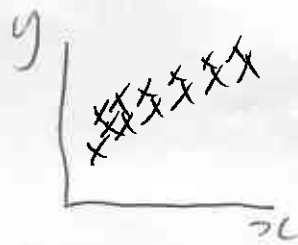


Lecture 16



①

Association - observe a relationship between two variables. eg as $x \uparrow$ so does $y \uparrow$

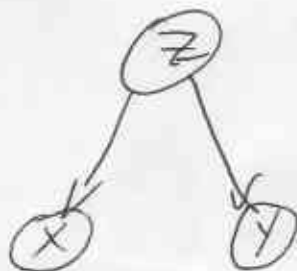
Causation - changing one variable leads to changes in the other variable. $(x) \rightarrow (y)$

Does Association imply Causation? NO

Just because two variables are ~~are~~ related does not mean there is a causal relationship between them.

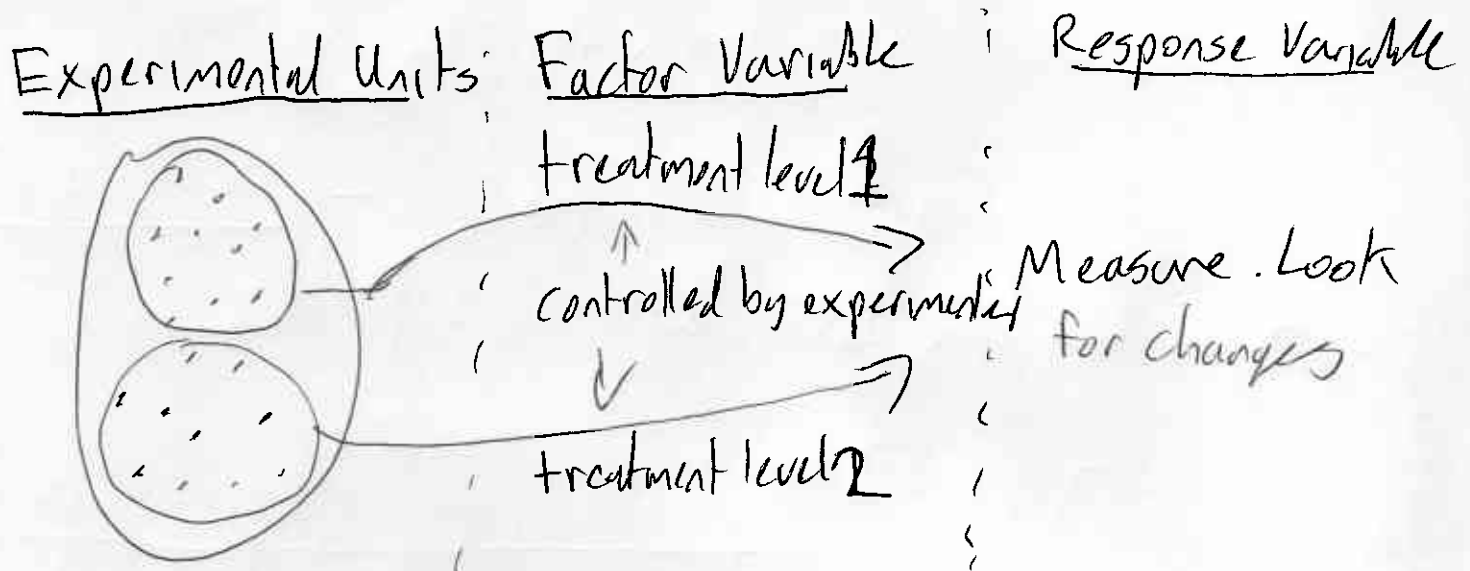
"Lurking Variable" an unmeasured variable that could explain both (or all) measured variables.

eg measure X, Y but ^{unmeasured} Z causes changes in X, Y



Then how do we show causal relationship? (2)

Use an experiment.



Problems

Bias - An experiment is biased if it systematically

favors certain outcomes.

Chance variation - ^{random} variations in individual experimental units.

How do you avoid it?

Placebo - useful in medical trials

Randomization - randomly assign experimental units to different treatment levels

Replicate - do the experiment at same factor levels on many individuals.