Causation

Lecture 4

Correlation and Causation

1. The regularity requirements

Hume's position implies that:

- If A causes B, then there is a regular connection between A's and B's – i.e. it is in general true that: if A then B.

Equally: Hume's position suggests that:

- If there is a regular connection between A's and B's – i.e. if it is in general true that: if A then B – then A causes B.

  (though one needs to bear in mind also his requirements of spatial contiguity and temporal priority).

  (for ease of exposition, and following Hume, I'm being a bit vague as to whether 'A' and 'B' are general types or particular tokens)

These implications should be assessed separately.

2. Preliminary conclusion

- At a common sense level Hume is right: we do get lightning/thunder regularities. But as science progresses singular causal claims typically draw upon background laws of nature which need not imply that there is a regular conjunction of cause-type and effect-type events.
- So once we get deeper into an explanation of what is going on, we lose the cause/effect regularities while gaining a grasp of the deeper laws that connect the properties exemplified in the situations which are cause and effect.

This move to ‘laws’ is a generalisation of Hume’s position, which gets us away from simple ‘conjunctions’ of cause and effect to deeper general connections. It makes it easier to deal with the issue of probability, by taking it that a singular causal claim can be backed by a probabilistic law.

But it does raise the question of what is distinctive of laws of nature – i.e. whether these are not themselves regularities, albeit more complex than Hume’s cause/effect conjunctions. We will come back to this below

3. Does regularity imply causation?

- But first we need to consider the implication from regularity to causation.
- Some such implication is obviously central to Hume's position, since we are supposed to derive our idea of necessary connexion, and thus causation, from experience of constant conjunction. And something of this kind must be right – for our evidence for causal claims, and proposed laws of nature, must be centrally of this kind.
- But there are many complexities here.

(i) ‘Common cause’ cases.

- There is a regular association between the time as indicated on different clocks (at least within the same time zone). Does that imply that there is a causal connection between these different clocks? Clearly not. Instead it indicates that there is a ‘common cause’ of their separate movements – namely that each, separately, has been set to indicate the local time.

- Similarly: consider the succession of night and day: is this a causal connection? surely not – instead these are separate effects of the earth’s daily rotation on its axis (and the relative position of earth and sun).

- A great deal of work goes into epidemiology to try to winnow out mere ‘correlations’, as they are called, from genuine causal connections. Here is an easy case: there is a clear association between ice-cream sales and the incidence of drowning. Does eating ice-cream somehow impair one’s ability to swim? No – for again there is a common cause which obviates any such speculation: when the weather is warm and sunny, ice-cream sales increase, and so does the number of people who go swimming outdoors. It’s just this increase in the number of people swimming which accounts for the increase in the number of drownings.

- Another case: it was discovered that children who develop serious myopia often sleep with the light on in their bedroom, and it was suggested that there is a causal connection here. The suggestion is not unreasonable; but a better explanation is that there is a common cause – the myopia of the parents. Myopic parents often have myopic children (the condition is heritable); and myopic parents often fail to notice that they have not turned off the light in their children's bedroom.

- etc. etc.

(ii) Confounding factors

- A different complication arises where there seems to be a robust association which looks causal – but it turns out that it is just a side effect of a deeper association. In a case of this kind the first association is said to involve a ‘confounding’ factor which screens off – until it is diagnosed – a more substantial factor.
- Here is a case: in the early stages of research into the causes of lung cancer it was noticed that there is a significant connection between living in an urban (as opposed to a rural) environment and increased incidence of lung cancer. The association with smoking was also noticed. But which is explanatory? (Perhaps both are)

- Mormons are prohibited from smoking; so few do smoke. Hence they provide a good test of the urban/rural hypothesis, separated from smoking/non-smoking complications. It turns out that the incidence of lung cancer among Mormons is generally low and not affected by the urban/rural distinction. That largely disproves the urban/rural hypothesis; and its apparent link with smoking is readily explained by the fact that smoking is (or was) a good deal more common among urban inhabitants than among rural inhabitants. So in this case, the urban/rural correlation with lung cancer was a ‘confounding’ factor, disguising – for a time – the link with smoking.

First conclusion

- All these cases show that the inference from correlation to causation is not straightforward.
- Is there a test one can apply to separate substantive connections from ‘mere’ correlations?
- There is no formal or ‘mechanical’ test: one has to think about possible common causes and confounding factors, and eliminate these by special trials - e.g. finding populations such as the Mormons who separate out the questions at issue. Medical trials often use ‘control groups’ with a placebo to make it easier to identify the distinctive effects of a new drug.

4. ‘Artificial’ regularities

- The cases so far involve genuine problems for statisticians and epidemiologists. But there are other counterexamples to the ‘regularity implies causation’ inference, of a more ‘artificial’ kind.

- Almost any physical object, however similar to others of the same kind, will have distinctive features that, as a matter of fact, single it out. So if we list these features, and then some further property of the object, we get a general truth: anything with those features has the property in question (so only one thing has those features, and it has the property too). But that regularity is not a causal connection.

- Again: take something which does not occur, though it is in principle possible; for example, there is no lump of gold which weighs ten tons, and we can be confident that there never will be. Hence: there is a ‘regular’ connection between being a lump of gold and weighing less than ten tons. But that is not a causal connection.

- Indeed take anything which as a matter of fact does not exist (and will never): we can manufacture any number of true but ‘vacuous’ regularities: for example, all lumps of gold which weigh more than ten tones are invisible. These vacuous regularities are clearly not causal connections.

It is clear that these cases involve spurious regularities. To exclude them we need to insist that

- (i) causal connections rest upon laws of nature;
- (ii) these spurious regularities are certainly not laws of nature;
- (iii) the role of (genuine) regularities, correlations etc. is to provide evidence for laws of nature.

5. But what is a law of nature?

How is a law of nature to be distinguished from a 'mere' regularity?

There is one easy intuitive test:

- a mere regularity 'All A's are B's' is an 'accidental' universal truth which does not warrant the counterfactual: 'if x had been an A it would have been a B'
- whereas where 'All A's are B's' is a law its scope extends beyond the actual to the possible, such that if x had been an A, it would have been a B.

- This, however, brings in ‘counterfactuals’ – which turn out to be very tricky and much disputed.
- In particular the result of counterfactual test is, arguably, downstream from the law/regularity distinction. It is an implication of that distinction, but not constitutive of it.

- (We will come back to counterfactuals in more detail later in the term)

There are three main alternative positions here:

- (i) Laws of nature state genuine necessary connections between properties which help to fix what is possible and what is not (Armstrong)
- (ii) Laws of nature express our determination to apply a regular connection to hypothetical possibilities (this is, in principle a non-cognitive account and can be seen as an interpretation of the (old) Humean position)
- (iii) Laws of nature are the general truths which occur either as axioms or as theorems of the best integrated theory of everything, where the main criteria for evaluating theories are simplicity and strength. (Lewis).

- We will come back to this debate later in the context of discussing how causation and counterfactuals fit together.