

# Causation

Philosophy of Economics

University of Virginia

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1. **Necessary and Sufficient Conditions**
2. Regularity Account
3. Probability Account
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# Necessary and Sufficient Conditions

- A is a necessary condition for B:  $B \rightarrow A$ 
  - if something is B, it must be/is A
  - this implies: if something is not-A, it's not-B
- A is a sufficient condition for B:  $A \rightarrow B$ 
  - if something is A, it must be/is B
  - this implies: if something is not-B, it's not-A

# The Problem

**A is a cause for B if and only if (iff) \_\_\_\_\_ .**

So there are two philosophical enterprises:

- Finding a Necessary Condition for Causation:  
If A is a cause for B, then \_\_\_\_\_ .
- Finding a Sufficient Condition for Causation:  
If \_\_\_\_\_ , then A is a cause for B.

# Functions for a Theory of Causation

- One aim is to develop a **metaphysical** theory of causation. The fundamental question is: *what is causation?*
- Another aim is to develop an **epistemological** theory of causation. The fundamental question is: *when do we know that something causes another thing?*
- Philosophers tend to be interested in the metaphysical question. It is not clear that scientists much care about this question
- Many scientists might assume intuitively that they know what a cause is. Instead, they are interested in concrete questions: how, within a specific field, do we identify causes and effects?

# Overview

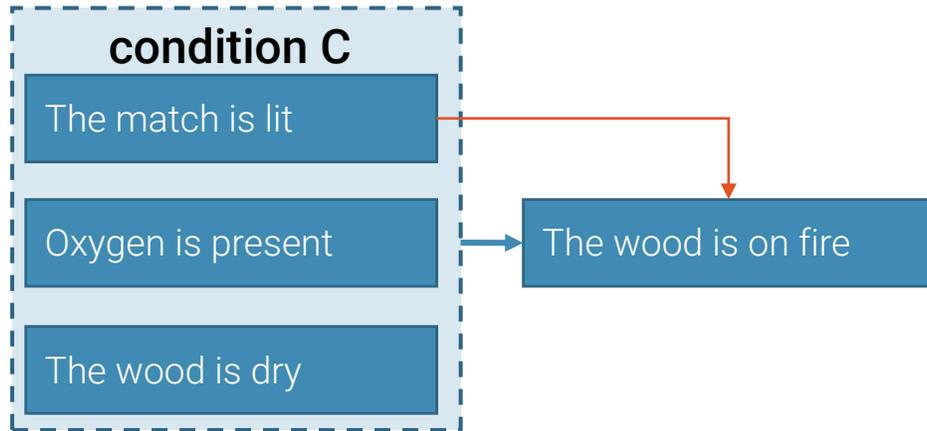
- **Regularity Account.**  $X$  is a cause of  $Y$  if and only if  $X$  is a member of an INUS condition for  $Y$
- **Probability Account.**  $X$  is a cause of  $Y$  if and only if (i)  $X$  antecedes  $Y$  in time, (ii)  $X$  is a prima facie cause of  $Y$ , and (iii) there is no earlier variable  $Z$  that screens off  $X$  from  $Y$ .
- **Process Account.**  $X$  is a cause of  $Y$  if and only if there is a causal process that connects  $X$  and  $Y$
- **Counterfactual Account.**  $X$  is a cause of  $Y$  if and only if (i) were  $X$  to happen,  $Y$  would happen; and (ii) were  $X$  not to happen,  $Y$  would not happen
- **Interventionist Account.**  $X$  is a cause of  $Y$  if and only if an appropriate manipulation of  $C$  results in a change of  $E$

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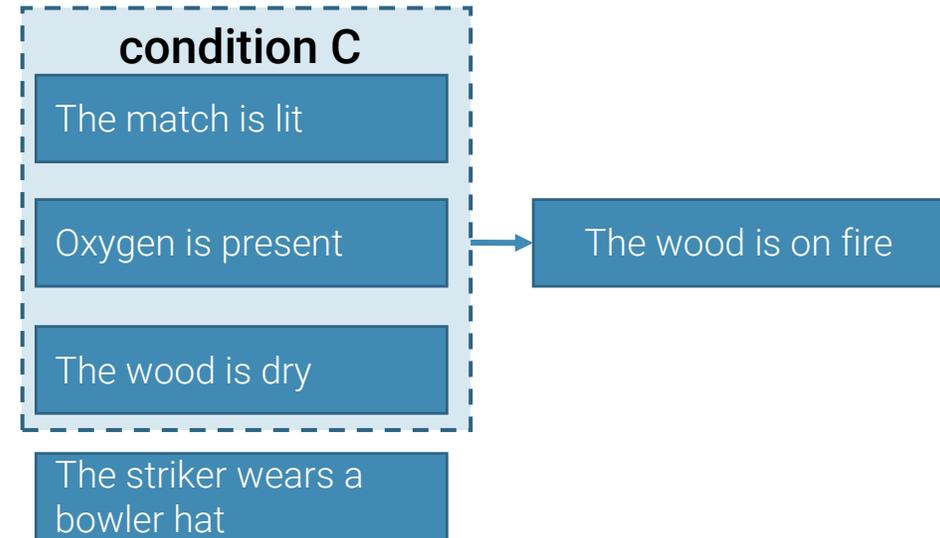
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# INUS condition



**Part 1:** For X to be cause, it must be an **insufficient** member of the condition C

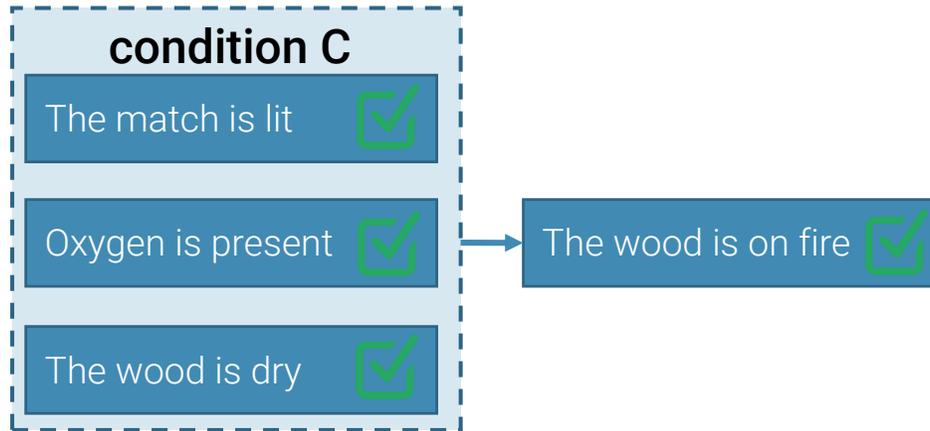
“The match is lit” is insufficient to ensure that the wood is on fire



**Part 2:** For X to be cause, it must be a **necessary** member of the condition S

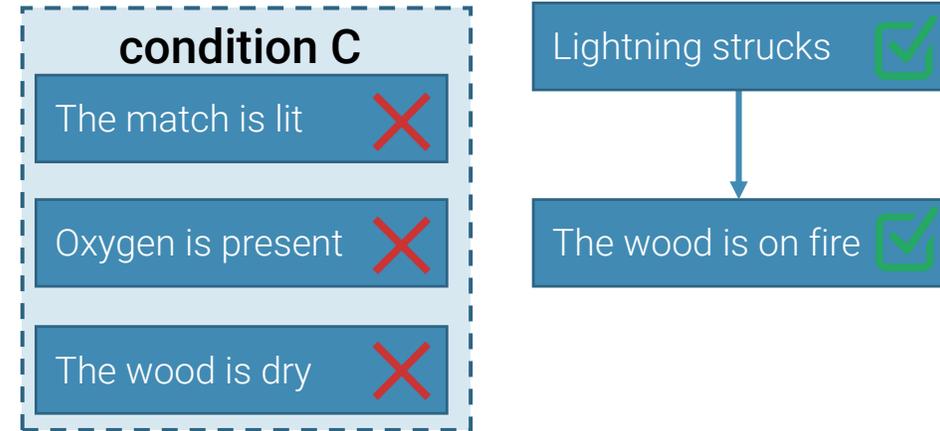
It is not necessary that “The striker wears a bowler hat” for condition C to obtain  
It is necessary that “The match is lit” for condition C to obtain

# INUS condition



**Part 3:** For X to be cause, the condition C to which it belongs must be **sufficient** for the outcome

If the match is lit, oxygen is present, and the wood is dry, then the wood is on fire.



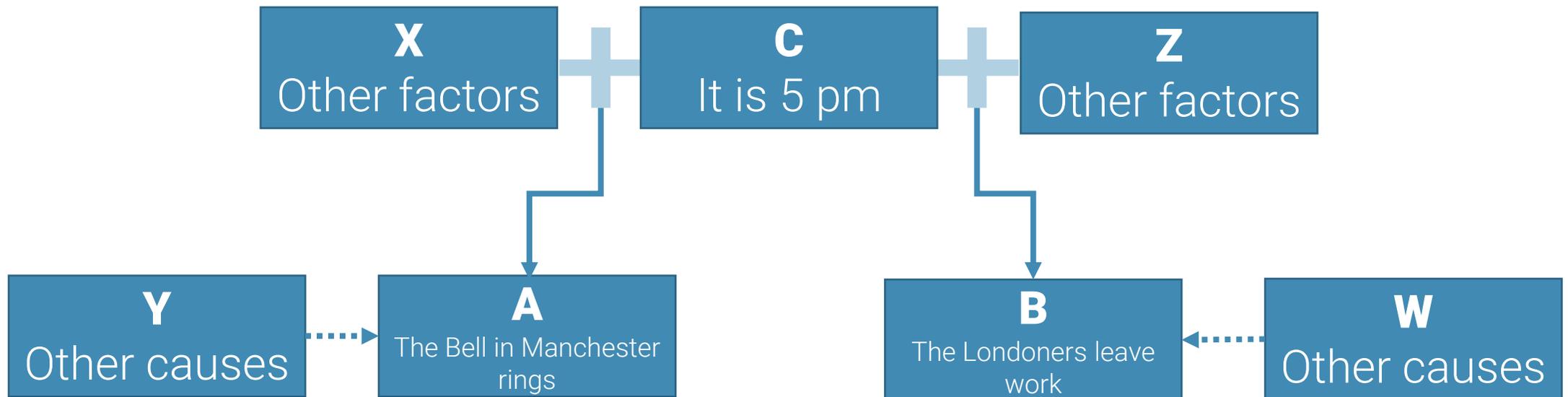
**Part 4:** For X to be cause, the condition C to which it belongs must not be **necessary** for the outcome

If the wood is on fire, it does not have to be the case that the match is lit, oxygen is present, and the wood is dry—e.g., lightning could have struck

# Regularity Accounts

- X causes Y if and only if X is a member of an INUS condition for Y
- Being an INUS condition is **not necessary** for causation
  - ❑ Indeterministic/stochastic causes
  - ❑ Smoking causes cancer, but smoking (with whatever other conditions we add) is not an INUS condition for cancer
- Being an INUS condition is **not sufficient** for causation
  - ❑ Epiphenomenal factors
  - ❑ Class size is an INUS condition for student performance, but it might not be a cause

# Counterexample: Causal Forks



**$A \sim YZ \text{ or } W \Leftrightarrow B$**

If  $\sim Y$  and  $A$ , we can be sure that  $C$ . If  $C$  and  $Z$ , we can be sure that  $B$ .

Therefore,  $A \sim YZ$  ensures  $B$ .

The bell in Manchester ringing is an INUS condition of the Londoners leaving work! (Check: why?)

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# Probabilistic Accounts

- **X is a prima facie cause** of Y if and only if (i) X antecedes Y in time, and (ii) X makes Y more likely
  - Mathematically:  $P(Y_{t+1}|X_t) > P(Y_{t+1})$
- How do we solve the problem of “causal forks”?
  - Define: **Z screens of X from Y** if and only if  $P(Y|X) > P(Y)$  and  $P(Y|X, Z) = P(Y|Z)$
  - $P(\text{Londoners leave their work} \mid \text{the bell in Manchester rings}) > P(\text{Londoners leave their work})$
  - but:  $P(\text{Londoners leave their work} \mid \text{the bell in Manchester rings, and it is 5pm}) = P(\text{Londoners leave their work} \mid \text{it is 5pm})$
- **Thus:** X is a cause of Y if and only if (i) X antecedes Y in time, (ii) X is a prima facie cause of Y, and (iii) there is no earlier variable Z that screens off X from Y.

# Probabilistic Accounts

- Why probability is **not sufficient** for causation
  - Correlated time series
- Why probability is **not necessary** for causation
  - Causal mechanisms which cancel out each other
  - Fortunate causal chains: you mishit the golfball onto the tree, which redirects it to the hole
    - but:  $P(\text{hit the hole} \mid \text{hit the tree}) < P(\text{hit the hole})$