

Logic of Causation

- Cause and effect
- Determinism vs. free will
- Explanation:

Why?

Causality

Bivariate relationship (2 variables)

X → Y

(Cause)

Independent
variable

(Effect)

Dependent
variable

Causality

Multivariate relationship
(3+ variables)

X

Y

Z

(Causes)

(Effect)

Independent
variables

Dependent
variable

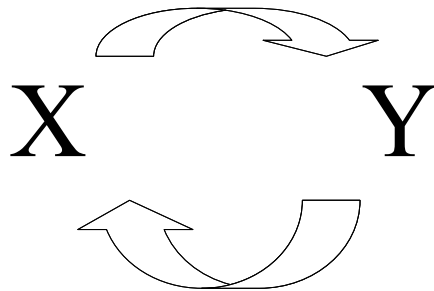
Criteria for Causality (n=3)

1) Cause must precede effect:

X \Rightarrow **Y**

Criteria for Causality

- 2) The two variables must be empirically associated



Criteria for Causality

- 3) Observed association cannot be explained away by a third variable (test for spuriousness)

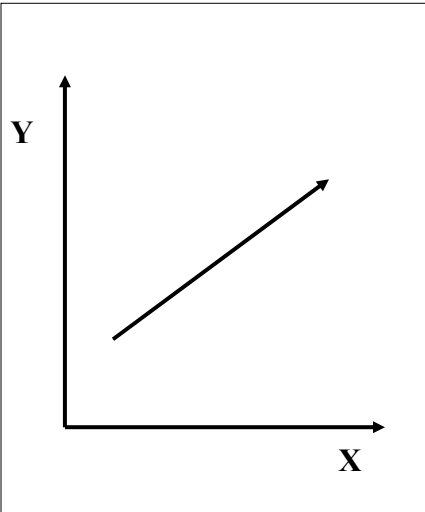
X = # firefighters

Y = amt. of damage

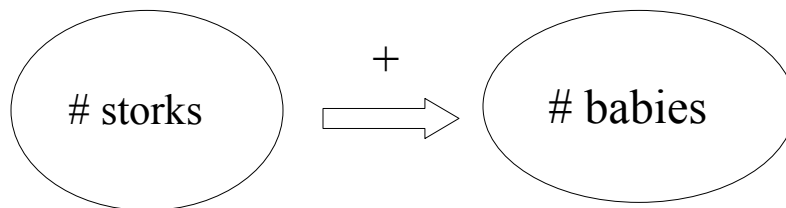
Criteria for Causality

X $\xrightarrow{+}$ **Y**

X = # firefighters
Y = amt. of damage



Spurious relationship?



Types of causes (n=2)

- Necessary cause: X must happen for Y to happen
“Need X to get Y”
- Sufficient cause: Y always happens when X happens
“Always get Y when you have X”