



## OVERVIEW

Not all relationships in data mean one thing caused another. This module explains the difference between association and causality—a critical skill for avoiding false conclusions. Learn how to tell when variables simply move together versus when one truly drives change.

### Association

- **Definition:** Variables change together, but no direct cause-effect.

Type	Description	Example
Positive	Both variables increase/decrease together.	Balloon size increases as water volume grows.
Negative	One variable increases while the other decreases.	Faster driving → Less travel time.
None	No observable relationship.	Day of the week vs. dice roll outcome.

### Causality

- **Definition:** One variable directly causes a change in another.
  - **Example:** Changing meeting time (independent variable) → Impact on attendance (dependent variable).

Key Differences:

Aspect	Association	Causality
Definition	Variables move together	One variable directly causes change
Proof	Requires observation	Requires controlled experiments

## Testing Causation

- **Identify:** Independent variable (e.g., meeting time).
- **Measure:** Dependent variable (e.g., attendance).
- **Control:** Keep other factors constant (e.g., day of the week).
- **Analyze:** Determine if the independent variable alone caused the change.

## Common Pitfalls

- **Definition:** Confusing association with causation:
  - **Example:** Employees in a wellness program take fewer sick days ≠ Program caused improvement (healthier employees may self-select).
- **Ignoring confounding factors:** Third variables (e.g., pre-existing health) can distort results.

## Real-World Applications

- **Public Health:** Does a vaccine reduce disease cases?
- **Policy:** Do food stamps improve nutrition?
- **Business:** Do loyalty programs boost customer retention?
- **Education:** Does study time affect test scores?

## Key Takeaways

- **Association ≠ Causation:** Always ask, "Is there a direct cause, or just a correlation?"
- **Design matters:** Use controlled experiments to establish causality.
- **Context is key:** Confounding variables can mislead interpretations.