Study Design

Q-> what is Study Design ?

-> It is overall plan/structure for how data is collected, analyzed, and interpreted.

-> Range from exploratory (just looking at data) -> to highly planned experiments (clinical trails, field studies, etc)

-> Different fields use study design:

- medice :-> clinical trail
- manufacturing :-> Reliability & quality studies
- Public helth -> observational studies
- market reserch, ~~eg~~ agriculture, surveys etc

- Type of Studies

(a) Exploratory vs confirmatory

- Exploratory
  - -> No pre-defined question
  - -> used to explore patterns / trends
  - -> Risks : Overfitting, multiple testing, P-hacking
- confirmatory
  - -> Has a specific hypothesis
  - -> Data is collected to test that hypothesis

(b) comparative vs non-comparative

- comparative : Force on difference
  - Exe-> compare yield of oranges with fertilizer A vs Fertilizer B.
  - Ex-> voter preference for candidate x vs candidate y.
- Non-comparative : focus on abosule Prediction/estimation
  - Ex-> Predict Stock Price 1 year from now.
  - Ex-> Estimate blood Pressure reduction after a drug.

(c) Observational vs Experimental

- observational
  - Data comes naturally (no random assignment)
  - Groups are self selected (smoker vs non smoker)
  - used when experiments are impractical or unethical
  - more prone to bias
- Experimental
  - Researcher assign treatments (random assignment)
  - Ex→ (i) Fertilizer applied to randomly chosen plots of land.
    (ii) A/B testing online ads.
  - Stronger evidence (less bias)

Important issues in Study design

- Power Analysis:
  → checks if the study design has enough data/ samples to detect meaningful effects.
- Bias:
  - Systematic error → result don't represent true population
  - Observational studies are more vulnerable.