Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias
  - Controls
  - Random Assignment to Treatment
  - Blinding

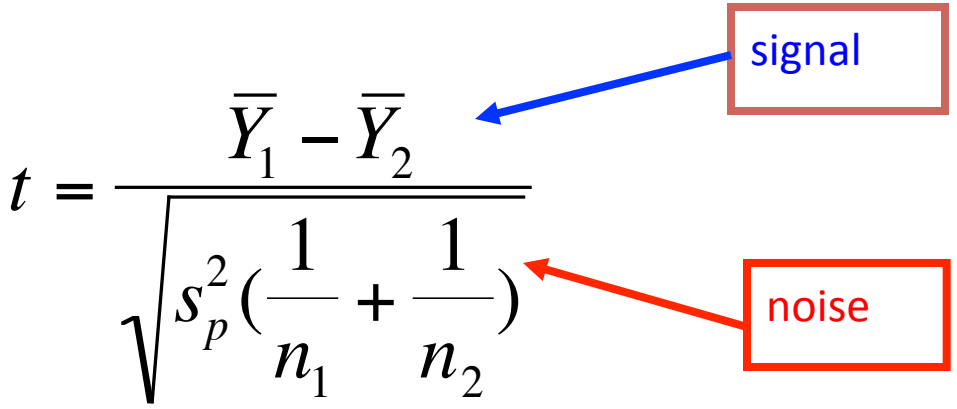
- Reduce Sampling Error
  - Replication
  - Balance
  - Blocking
  - Extreme Treatments

Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - How to detect treatment effects against a background of variation between individuals
  - Increasing **signal** to **noise** ratio



Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - How to detect treatment effects against a background of variation between individuals
  - Increasing **signal** to **noise** ratio
    - If the 'noise' $\sqrt{s_p^2(\frac{1}{n_1}+\frac{1}{n_2})}$ is smaller, it is easier to detect a given 'signal'
      - » Can be achieved with small *s* or larger *n*

Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - Replication:

    - Carry out study on multiple independent experimental units
      - **Experimental units** -the independent unit to which treatments are assigned

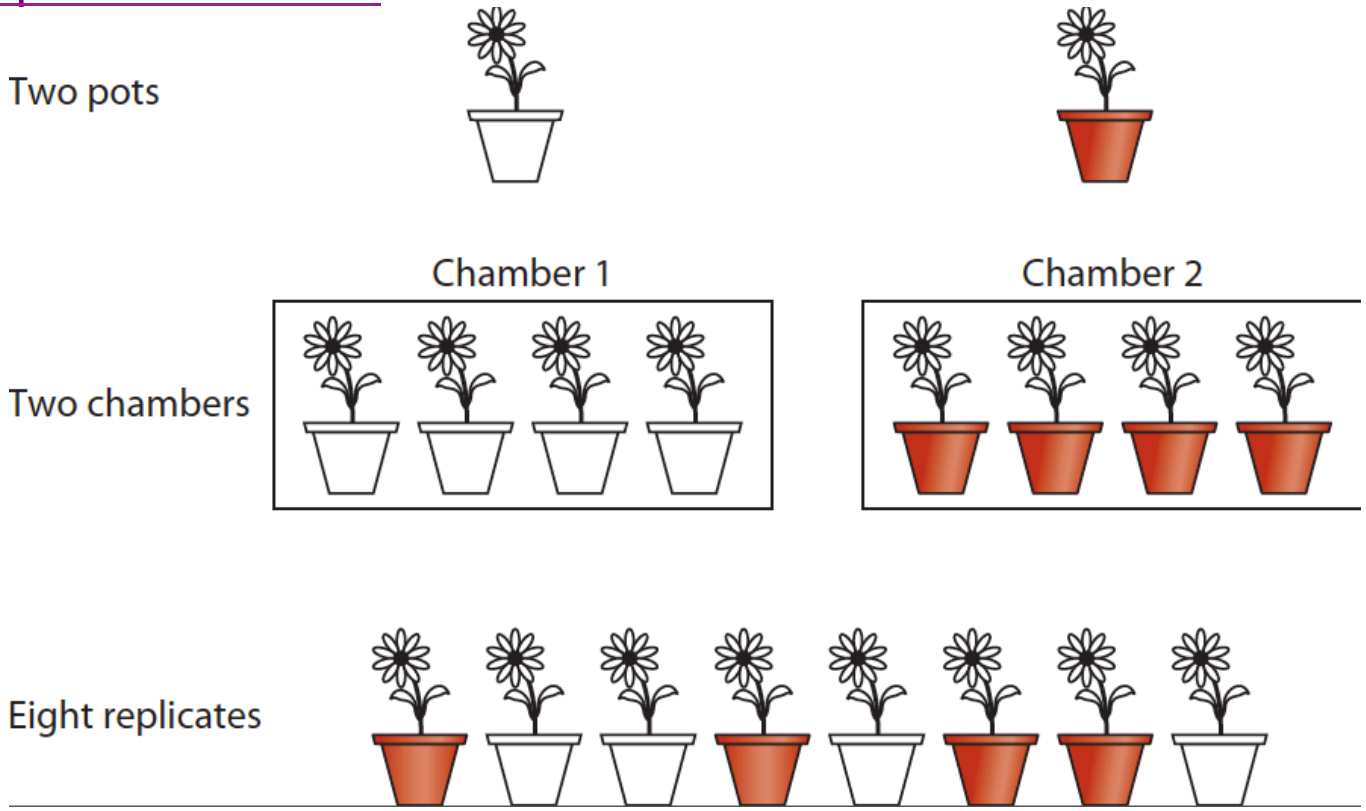
    - A 'give away' of a replicated design is the interspersion of experimental units assigned to different treatments

Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - Replicated or not?



Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - Balance:
    - All treatments have (nearly) the same sample size
    - See this by looking at the formula:

$$\sqrt{s_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}$$

    - Balance increases precision by decreasing SE
    - When $n_1 \approx n_2$, this is smallest because $(1/n_1 + 1/n_2)$ is smallest for any n_{total}

Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - Blocking:

    - Grouping of experimental units with similar properties
    - Strategy that accounts for extraneous variation

    - Method:
      - Within blocks, treatments are randomly assigned to experimental units
      - Differences between treatments are evaluated only within blocks so that any differences that are due to blocks rather than treatments can be discarded

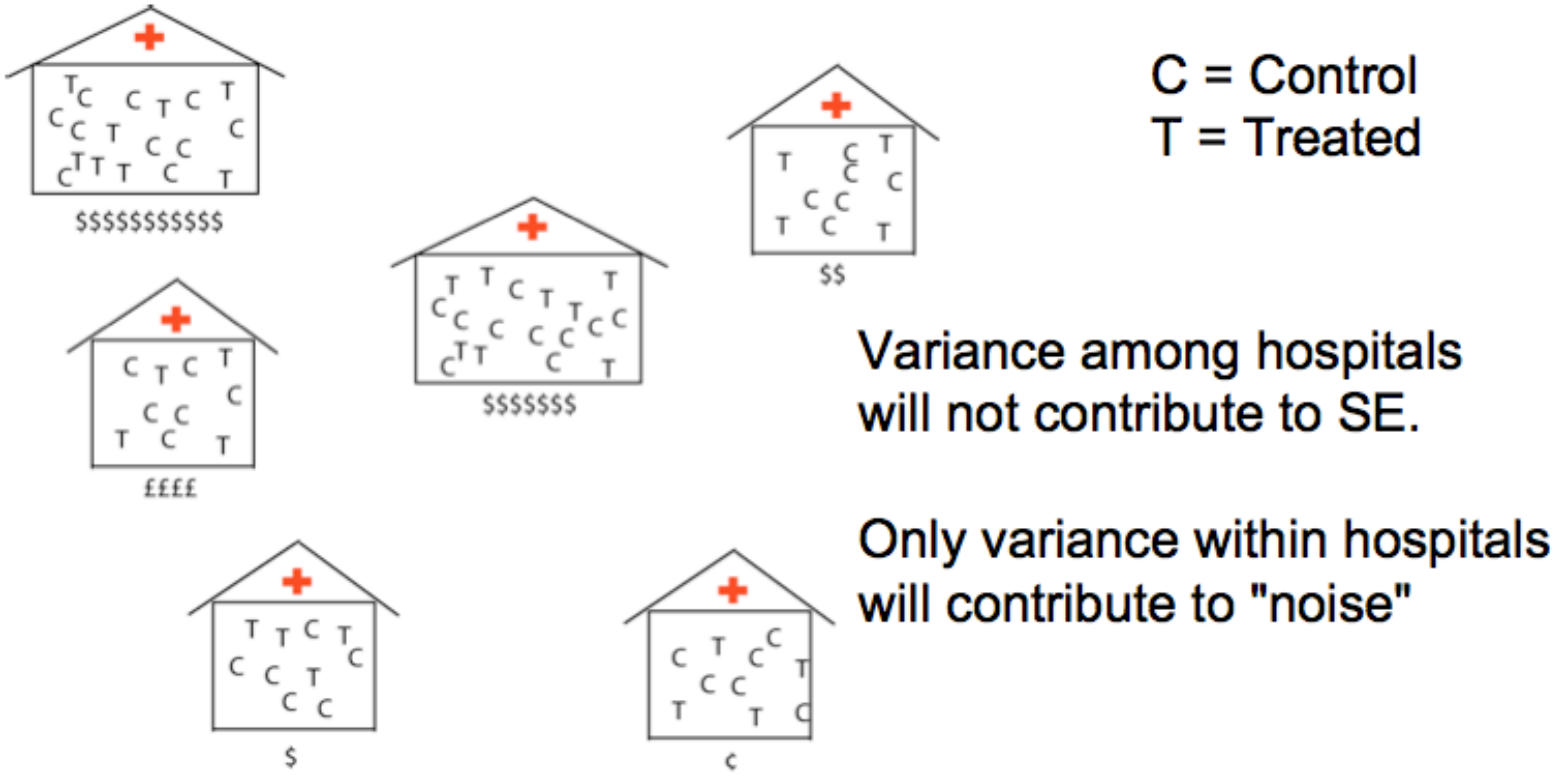
      - **Randomized block design** - like a paired design but for > 2 treatments

Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - Blocking:



C = Control
T = Treated

Variance among hospitals will not contribute to SE.

Only variance within hospitals will contribute to "noise"

Goals of experiments:

determine how explanatory variable (treatment) affects response variable

- Eliminate Bias

- Reduce Sampling Error
  - Extreme Treatments:

    - Good first step to determine if a treatment is worthy further study

    - **Beware that treatment effects do not always scale linearly**
      - An extreme does may be qualitatively different from a smaller dose