Lecture 3: Randomization

**Three Principles**
- Control.
- Replication.
- Randomization.

**Randomization**
- Random assignment of treatments to experimental units.
- Random selection of experimental units.

**Random Assignment**
- Let chance determine which treatment is assigned to each experimental unit.
- Random assignment tends to reduce the chance that an uncontrolled outside variable will bias the results of the experiment.

**How to assign treatments?**
- We have 20 men with Stage 1 hypertension and we wish to assign the low sodium diet to 10 and the high sodium diet to the other 10.
- Systematic assignment – alternate the treatments, first man gets 50 mmol Na, second man gets 200 mmol Na, third man gets 50 mmol Na, etc.
Systematic Assignment?

* Systematic assignment can give biased results if there is something about every other man that affects blood pressure.

Systematic Assignment?

* Because we don’t know if there is a hidden variable affecting every other man, we should avoid using systematic assignment.

Random Assignment

* Lottery system – put 10 red balls and 10 yellow balls in a lottery machine and mix thoroughly. Let each man draw a ball, without replacement.

Random Assignment

* Using a lottery system will guarantee that every possible assignment of treatments to men is equally likely.

Random Assignment

* Use a random number generator – take the numbers from 1 to 20 and use a computer program to randomly shuffle them.

Random Assignment

* Have the men line up and take a shuffled number, those with odd numbers get one treatment those with even numbers get the other treatment.
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**JMP**

*Create a column labeled Random Number.
*Add 20 rows.
*Col – Formula – Random – Col Shuffle

**Random Assignment**

*Flip a fair coin – flip a fair coin for each man, Heads is 50 mmol diet, Tails is 200 mmol diet.

**Stopping Rule**

*When 10 men are in one group all the rest of the men go into the other group.
*It is more likely that men at the beginning or end will be in the same group.

**Random Assignment**

*Flipping a coin will work as long as you don’t specify the number of men in each group.

**Stopping Rule**

*Because not all assignments are equally likely using a coin and a stopping rule, this method should be avoided.
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Randomization

* Random selection of experimental material from a larger population.

Random Selection

* Allows us to make generalizations to the population from which the material was selected.

Random Selection

* Suppose we have a large population of men with Stage 1 hypertension and we select 20 at random to be in the experiment.

Generalization

* If we find that men on the high sodium diet have statistically higher average blood pressure we can say that other men from the population will have higher average blood pressure if given a high sodium diet.

Generalization

* Without random selection, we would need to replicate the entire experiment with new men in order to see if the results are repeatable.

Randomization

* Random assignment of treatments to experimental units is essential for a well designed experiment.