

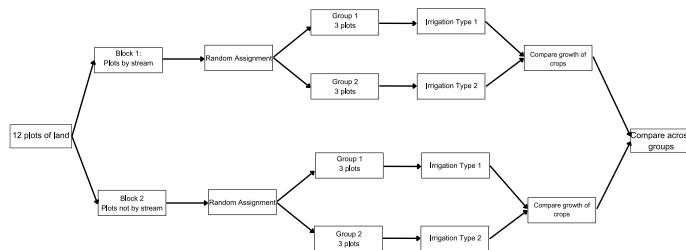
1.
 - a. In a completely randomized design, treatments are assigned to experimental units completely at random. In a randomized block design, experimental units are separated into groups (blocks) by a common characteristic that is thought to affect the response to a treatment. Then treatments are assigned completely at random within each block.
 - b. In a matched-pairs design, subjects are grouped together in pairs, or blocks, based on a similar characteristic. Then treatments are assigned completely at random within each pair (block).

2.
 - a. Randomly assign half of the 300 teachers to receive the monthly bonus of \$200. The remaining teachers will not receive the monthly bonus. At the end of the year, the researchers will compare the retention rates of the two groups.
 - b. The level of school (elementary, middle, or high) might affect whether or not a teacher continues teaching at the end of the year. It is possible that one level is more challenging than another, so a higher percentage of teachers at that level are leaving the profession than teachers at the other levels.
 - c. The researchers should do a randomized block design. Separate the teachers by level (elementary, middle, high) and randomly assign the bonuses to half of the teachers in each block. The other half of the teachers in each block will not receive a bonus. At the end of the year, the researchers will compare the retention rates within each block and across the three blocks.
 - d. Assign the teachers in each group a unique number from 1 to 100. Use a random number generator to generate 50 numbers from 1 to 100 (no repeats). Assign the teachers corresponding to the numbers selected to receive the monthly bonus. The remaining teachers in that block will receive no monthly bonus. Repeat this process for each block.

3.
 - a. The experimental units are the 20 soccer players willing to participate in the study. The treatments are the new shin guard and the standard shin guard. The response variable is the rating of comfortability on a scale of 1 to 10.
 - b. Matched-pairs design. Each subject receives both treatments.
 - c. For each player, flip a coin to determine which shin gets which shin guard. If the coin lands on heads, the player will wear the new shin guard on their left shin and the standard shin guard on their right shin. If the coin lands on tails, the player will wear the standard shin guard on their left shin and the new shin guard on their right shin. Repeat for all 20 players.
 - d. In this matched-pairs design, the players are comparing their right shin to their left shin. Their criteria for comfortability will be the same for each shin guard, which will produce a more precise estimate for the rating of comfortability. In a completely randomized design, it's possible that players who are more sensitive will all get randomly assigned the same type of shin guard.

4.
 - a. The age of the patients should be chosen to create the blocks because age is more likely to have an impact on joint pain and mobility in physical therapy patients.
 - b. A randomized block design will have less variability in results within each block, making it easier to determine which type of exercise is most effective in reducing joint pain and increasing mobility in these patients. In a completely randomized design, it's possible that all patients who receive one type of exercise as the treatment are older and already have more joint pain, which would make it more difficult to determine if the exercise was effective.
5.
 - a. Option 1 is better for this experiment. The distance from the stream may affect the growth of the crops, so Option 1 would guarantee that each type of plot (near the stream or not near the stream) would receive both types of irrigation. This will reduce the variability in growth of the crops within the blocks, making it easier to determine which type of irrigation system is more effective.

b.



- c. Random assignment tends to balance the effects of confounding variables, such as the amount of sunlight a plot receives or the quality of the soil, so that differences in crop growth can be attributed to the type of irrigation (we can show causation).

6. B

7. C