

Randomizing a BIBD:

Example: We want to compare four hamburger restaurants: B, M, W, Z, but subjects can only try three burger samples before getting nauseated. Let's use a BIBD.

Here is a BIBD for $g = 4$, $k = 3$, and $b = 4$:

| Run | Treatments | | |
|-----|------------|---|---|
| 1 | 1 | 2 | 3 |
| 2 | 1 | 2 | 4 |
| 3 | 1 | 3 | 4 |
| 4 | 2 | 3 | 4 |

First we randomize the 'runs' to subjects, using the random permutation of 2,4,1,3:

| Subject | Treatments | | |
|---------|------------|---|---|
| 1 | 1 | 2 | 4 |
| 2 | 2 | 3 | 4 |
| 3 | 1 | 2 | 3 |
| 4 | 1 | 3 | 4 |

Now randomize the order of treatments for each subject using separate random permutations. The 'X' symbol denotes a treatment not used for that subject:

| Subject | Treatments | | | Permutation | | | |
|---------|------------|---|---|-------------|---|----|----|
| 1 | 2 | 4 | 1 | 2 | 4 | 3X | 1 |
| 2 | 3 | 4 | 2 | 3 | 4 | 1X | 2 |
| 3 | 1 | 2 | 3 | 4X | 1 | 2 | 3 |
| 4 | 1 | 4 | 3 | 1 | 4 | 3 | 2X |

Finally, we randomize the treatments to the treatment numbers. Using the random permutation 2,4,3,1, we assign treatment 2 to letter B, treatment 4 to letter M, treatment 3 to letter W, and treatment 1 to letter Z, giving us a design we can now use:

| Subject | Treatments | | |
|---------|------------|---|---|
| 1 | B | M | Z |
| 2 | W | M | B |
| 3 | Z | B | W |
| 4 | Z | M | W |

Reference:

Kuehl, R.O. Design of Experiments: Statistical Principles of Research Design and Analysis, second edition. 2000. Belmont, CA: Brooks/Cole