Randomized Block Design

In a **randomized block design**, there is only one primary factor under consideration in the experiment. Similar test subjects are grouped into **blocks**. Each block is tested against all treatment levels of the primary factor at random order. This is intended to eliminate possible influence by other extraneous factors.

**Example**

A fast food franchise is test marketing 3 new menu items. To find out if they have the same popularity, 6 franchisee restaurants are randomly chosen for participation in the study. In accordance with the randomized block design, each restaurant will be test marketing all 3 new menu items. Furthermore, a restaurant will test market only one menu item per week, and it takes 3 weeks to test market all menu items. The testing order of the menu items for each restaurant is randomly assigned as well.

**Problem**

Suppose each row in the following table represents the sales figures of the 3 new menu in a restaurant after a week of test marketing. At .05 level of significance, test whether the [mean](http://www.r-tutor.com/node/35)sales volume for the 3 new menu items are all equal.

 Item1 Item2 Item3   
    31    27    24   
    31    28    31   
    45    29    46   
    21    18    48   
    42    36    46   
    32    17    40

**Solution**

The solution consists of the following steps:

1. Copy and paste the sales figure above into a [table file](http://www.r-tutor.com/node/69) named "fastfood-2.txt" with a text editor.

Done

1. Load the file into a [data frame](http://www.r-tutor.com/node/10) named df2 with the read.table function. As the first line in the file contains the column names, we set the header argument as TRUE.

> df2 = read.table("fastfood-2.txt", header=TRUE); df2   
  Item1 Item2 Item3   
1    31    27    24   
2    31    28    31   
3    45    29    46   
4    21    18    48   
5    42    36    46   
6    32    17    40

Done

1. Concatenate the data rows in df2 into a single vector r .

> r = c(t(as.matrix(df2))) # response data   
> r   
 [1] 31 27 24 31 28 ...

Done

1. Assign new variables for the treatment levels and number of control blocks.

> f = c("Item1", "Item2", "Item3")   # treatment levels   
> k = 3                    # number of treatment levels   
> n = 6                    # number of control blocks

Done

1. Create a vector of treatment factors that corresponds to the each element in r of step 3 with the gl function.

> tm = gl(k, 1, n\*k, factor(f))   # matching treatment   
> tm   
 [1] Item1 Item2 Item3 Item1 Item2 ...

Done

1. Similarly, create a vector of blocking factors for each element in the response datar.

> blk = gl(n, k, k\*n)             # blocking factor   
> blk   
 [1] 1 1 1 2 2 2 3 3 3 4 4 4 5 5 5 6 6 6   
Levels: 1 2 3 4 5 6

Done – not sure I understand

1. Apply the function aov to a formula that describes the response r by both the treatment factor tm and the block control blk.

> av = aov(r ~ tm + blk)

Done

1. Print out the ANOVA table with the summary function.

> summary(av)   
            Df Sum Sq Mean Sq F value Pr(>F)   
tm           2    539     269    4.96  0.032 \*   
blk          5    560     112    2.06  0.155   
Residuals   10    543      54

Done

**Answer**

Since the p-value of 0.032 is less than the .05 significance level, we reject the null hypothesis that the mean sales volume of the new menu items are all equal.

**Exercise**

Create the response data in step 3 above along *vertical*columns instead of horizontal rows. Adjust the factor levels in steps 5 and 6 accordingly.