Randomized Block Design

Introduction

A randomized block design is a type of experiment where participants who share certain characteristics are grouped together to form blocks, and then the treatment (or intervention) gets randomly assigned within each block. The objective of the randomized block design is to form groups where participants are similar, and therefore can be compared with each other.

ANOVA Table for a Randomized Block Design

Source	df	SS	MS	F
Treatments	$k-1$	SST	$MST = SST/(k-1)$	MST/MSE
Blocks	$b-1$	SSB	$MSB = SSB/(b-1)$	MSB/MSE
Error	$n-k-b+1$	SSE	$MSE = SSE/(n-k-b+1)$	
Total	$n-1$	$TotalSS$		

Procedure:

- Import the data set
- Determine the summary and ANOVA using R functions
- Visualize the problem using R functions

Problem:

The following table gives monthly sales (in thousand rupees) of a certain firm in the 3 states by its four salesmen.

States	**Salesmen**			
	I	II	III	IV
A	6	5	3	8
B	8	9	6	5
C	10	7	8	7

Setup the analysis of variance table and test whether there is any significant difference (i) between the salesmen (ii) between sales in the states.

Code and Results:

```
#Monthly sales of States
StateA=c(6,5,3,8)
StateA

## [1] 6 5 3 8

StateB=c(8,9,6,5)
StateB
```

```
## [1] 8 9 6 5
```

```
StateC=c(10,7,8,7)
StateC
```

```
## [1] 10  7  8  7
```

```
#frame the data set
Group<-data.frame(cbind(StateA,StateB,StateC))
Group
```

```
##   StateA StateB StateC
## 1      6      8     10
## 2      5      9      7
## 3      3      6      8
## 4      8      5      7
```

```
Sales=c(t(as.matrix(Group))); Sales
```

```
##  [1]  6  8 10  5  9  7  3  6  8  8  5  7
```

```
f=c("State A","State B","State C")
f
```

```
## [1] "State A" "State B" "State C"
```

```
g=c("Salesman1","Salesman2","Salesman3","Salesman4")
g
```

```
## [1] "Salesman1" "Salesman2" "Salesman3" "Salesman4"
```

```
# number of columns
k=ncol(Group)
k
```

```
## [1] 3
```

```
# number of rows
n=nrow(Group)
n
```

```
## [1] 4
```

```
# Generate factor levels of States
States=gl(k,1,n*k,factor(f))
States
```

```
##  [1] State A State B State C State A State B State C State A State B State
C
## [10] State A State B State C
## Levels: State A State B State C
```

```r
# Generate factor levels of Salesmen
Salesmen=gl(n,k,n*k,factor(g))
Salesmen
```

```
##  [1] Salesman1 Salesman1 Salesman1 Salesman2 Salesman2 Salesman2 Salesman3
##  [8] Salesman3 Salesman3 Salesman4 Salesman4 Salesman4
## Levels: Salesman1 Salesman2 Salesman3 Salesman4
```

```r
# ANOVA table
anova=aov(Sales ~ States + Salesmen)
summary(anova)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## States       2 12.667   6.333   1.839  0.238
## Salesmen     3  8.333   2.778   0.806  0.535
## Residuals    6 20.667   3.444
```