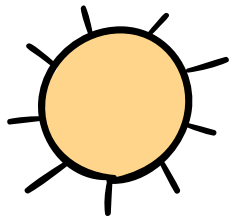
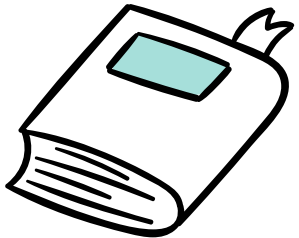
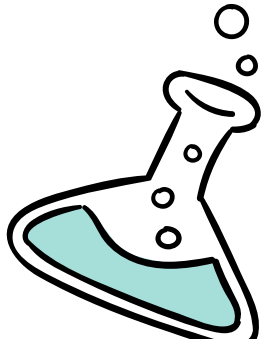
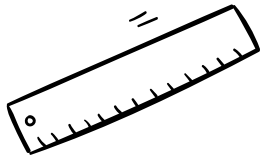
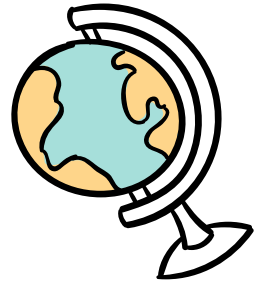





EXPERIMENTAL LAYOUT RANDOMIZATION AND ANOVA USING R STUDIO





Experimental design | R package

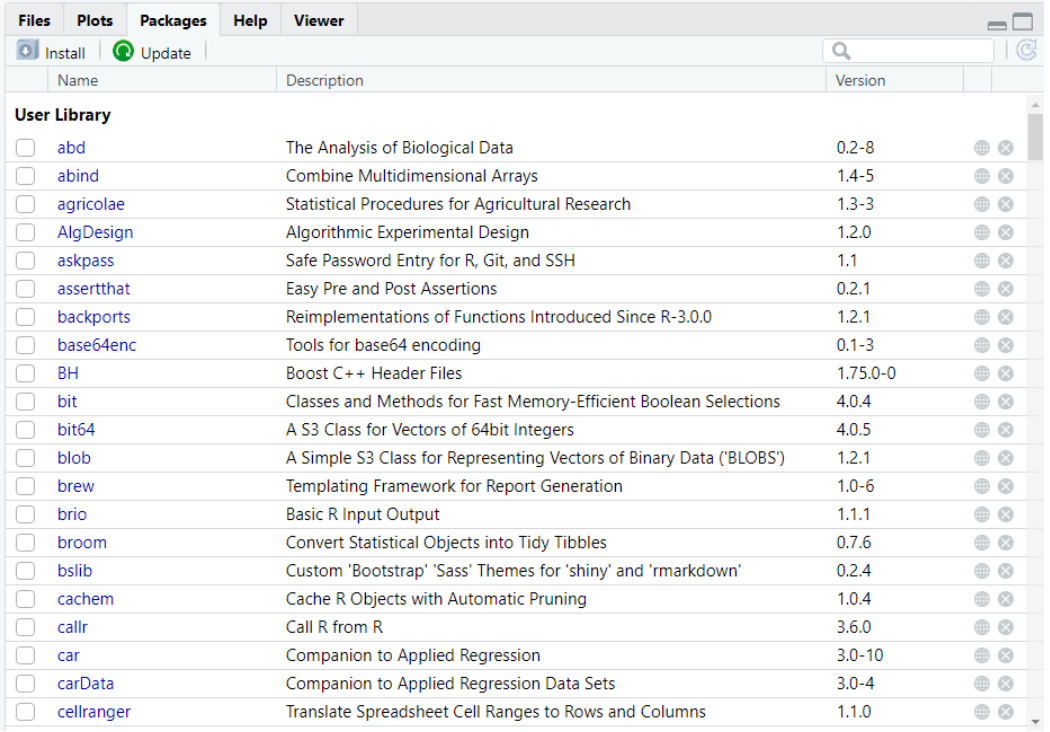
Installing a package in R

- R comes in a set of ***base*** packages stored in system library → basic statistics and graphics functions
- There are other ***add-on*** *packages* that can run fancier graphs and other complicated statistical analysis which are not provided by the ***base*** package.
- The add-on package can be downloaded for free from CRAN website. These packages is stored in the user library once installed.

Experimental design | R package

Examples of package

- Some examples of R packages:
  - `ggplot2` – graphics (graphs)
  - `agricolae` – experimental design and analysis in agriculture
- The packages can be installed using the "Package" tab in the lower right panel or use "`install.packages()`" command
- After install, the package need to be activated using "`library()`" function before using all the functions in that package



Experimental design | R package

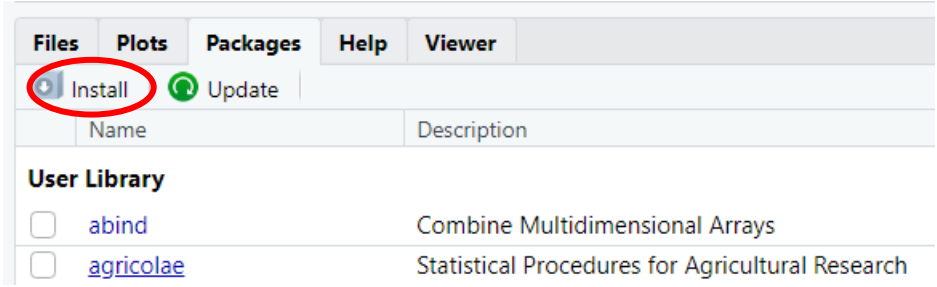
The 'agricolae' package

- The **agricolae** package offers a broad functionality in the designs of experiments especially in agriculture, which can also be used in other fields.
- This package offers statistical analysis in experimental designs that are commonly used in agricultural research such as completely randomized design, randomized complete block design, latin square, split plot and other designs.
- Further details on the analysis are provided in the package documentation (vignette)

Experimental design | R package

The 'agricolae' package

- Layout randomization can be conducted using the 'agricolae' package.
- The package needs to be installed in your computer before using the codes for this package (Thus, internet connection is required for the installation)
- To install the 'agricolae' package:
  - Use codes: `install.packages('agricolae')`
  - Or you can click the install package button at the Package tab in R Studio, and search for the 'agricolae' package



Experimental design | R package

The 'agricolae' package

- The documentation or vignette about the package can be viewed at: https://cran.r-project.org/web/packages/agricolae/vignettes/tutorial.pdf
- This documentation provides explanation about the function and some examples how to use and the output

agricolae tutorial (Version 1.3-5)

Felipe de Mendiburu[1]

2021-06-05

1

Preface

The following document was developed to facilitate the use of agricolae package in R, it is understood that the user knows the statistical methodology for the design and analysis of experiments and through the use of the functions programmed in agricolae facilitate the generation of the field book experimental design and their analysis. The first part document describes the use of graph.freq role is complementary to the *hist* function of R functions to facilitate the collection of statistics and frequency table, statistics or grouped data histogram based training grouped data and graphics as frequency polygon or ogive; second part is the development of experimental plans and numbering of the units as used in an agricultural experiment; a third part corresponding to the comparative tests and finally provides agricolae miscellaneous additional functions applied in agricultural research and stability functions, soil consistency, late blight simulation and others.

```
> oldpar<-par(mfrow=c(2,2),mar=c(3,3,2,1),cex=0.7)
> c1<-colors()[480]; c2=colors()[65]
> bar.err(outHSD$means, variation="range",ylim=c(0,50),col=c1,las=1)
> bar.err(outHSD$means, variation="IQR",horiz=TRUE, xlim=c(0,50),col=c2,las=1)
> plot(outHSD, variation="range",las=1)
> plot(outHSD, horiz=TRUE, variation="SD",las=1)
> par(oldpar)
```

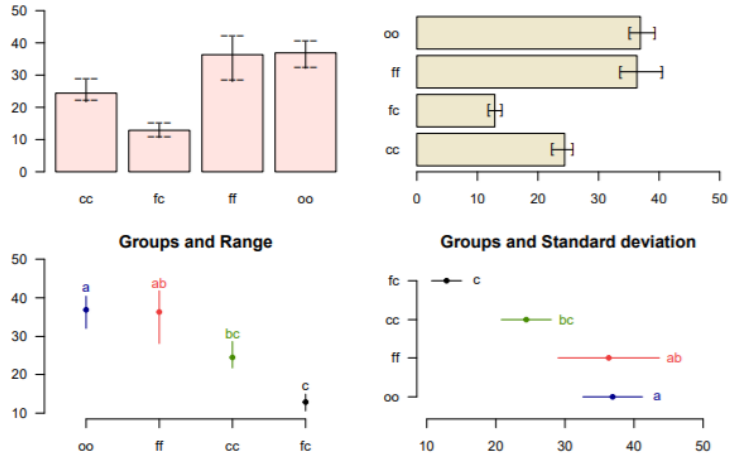


Figure 5: Comparison between treatments

Experimental design | Layout randomization

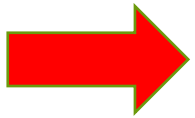
Completely randomized design (CRD)

- R codes:

```
trt <- c("T1", "T2", "T3")
rep <- c(4, 4, 4)
outdesign <- design.crd(trt,r=rep,serie=0)
(book1 <- outdesign$book) # parentheses to display output right away
```

- Output:

```
   plots r trt
1      1 1  T1
2      2 1  T2
3      3 1  T3
4      4 2  T3
5      5 2  T2
6      6 2  T1
7      7 3  T2
8      8 3  T3
9      9 3  T1
10    10 4  T1
11    11 4  T3
12    12 4  T2
```



plots	r	trt
1	1	T1
2	1	T2
3	1	T3
4	2	T3
5	2	T2
6	2	T1
7	3	T2
8	3	T3
9	3	T1
10	4	T1
11	4	T3
12	4	T2

Plot number

1	2	3
4	5	6
7	8	9
10	11	12

Assignment of treatments to plot number

T1	T2	T3
T3	T2	T1
T2	T3	T1
T1	T3	T2

Experimental design | Layout randomization

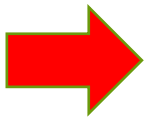
Randomized complete block design (RCBD)

- R codes:

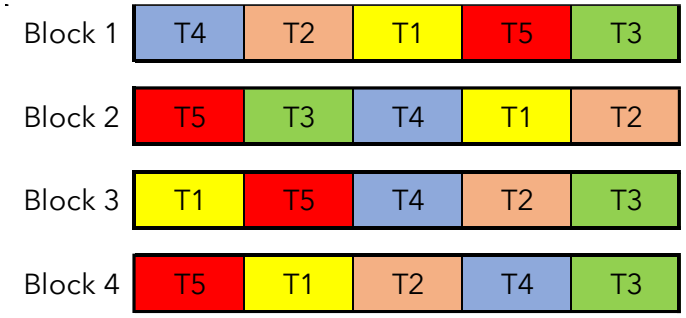
```
trt <- c("T1", "T2", "T3","T4","T5")
rep <- 4
outdesign <- design.rcbd(trt,r=rep, serie=2)
book2<- zigzag(outdesign) # zigzag numeration
print(outdesign$sketch)
```

- Output:

```
     [,1] [,2] [,3] [,4] [,5]
[1,] "T4" "T2" "T1" "T5" "T3"
[2,] "T5" "T3" "T4" "T1" "T2"
[3,] "T1" "T5" "T4" "T2" "T3"
[4,] "T5" "T1" "T2" "T4" "T3"
```



	[,1]	[,2]	[,3]	[,4]	[,5]
[1,]	T4	T2	T1	T5	T3
[2,]	T5	T3	T4	T1	T2
[3,]	T1	T5	T4	T2	T3
[4,]	T5	T1	T2	T4	T3



Analysis of variance | R codes

The codes for each design follows the components in the statistical model

Completely randomized design (CRD)

To fit the ANOVA (CRD) model:

```
fit1 <- lm (y ~ trt , data=data)
```

Display the output:

```
anova(fit1)
```

Linear additive model for CRD

Y = mean + **treatment** + error

Randomized complete block design (RCBD)

To fit the ANOVA (RCBD) model:

```
fit2 <- lm (y ~ trt + block, data=data)
```

Display the output:

```
anova(fit2)
```

Linear additive model for RCBD

Y = mean + **treatment** **+** **block** + error