

# 13.3 Randomized Complete Block Design

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## Base R

Within base R, to do a Tukey Test, it's necessary to have the data saved in three columns: and 'Outcome' column with the values of the response variable, a 'Block' column with the block values, and a 'Treatment' column with the treatment values. Use the data from Example 2.

```
Outcomes <- c(15, 17.9, 17.5, 16.3, 15.4, 14.6, 17.4, 14.8, 17.3, 19.3, 17.7, 16, 14.2, 14.4, 18.8, 10.4, 12.2, 14.8, 12, 14.3)

Treatments <- factor(rep(c('Diet 1', 'Diet 2', 'Diet 3', 'Diet 4'), each = 5))

# NOTE: each = 5 means to repeat each factor five times.

Blocks <- factor(rep(c('Block 1','Block 2','Block 3','Block 4','Block 5'), 4))

# NOTE: the "4" is shorthand for 'times = 4'. So, instead of repeating an element a certain number of times, the sequence (Block1, Block2, Block3, ...) repeats a certain number of times.

Block_data <- data.frame('Outcomes' = Outcomes, 'Treatments' = Treatments, 'Blocks' = Blocks)

head(Block_data,n=7)

##   Outcomes Treatments  Blocks
## 1    15.0      Diet 1 Block 1
## 2    17.9      Diet 1 Block 2
## 3    17.5      Diet 1 Block 3
## 4    16.3      Diet 1 Block 4
## 5    15.4      Diet 1 Block 5
## 6    14.6      Diet 2 Block 1
## 7    17.4      Diet 2 Block 2
```

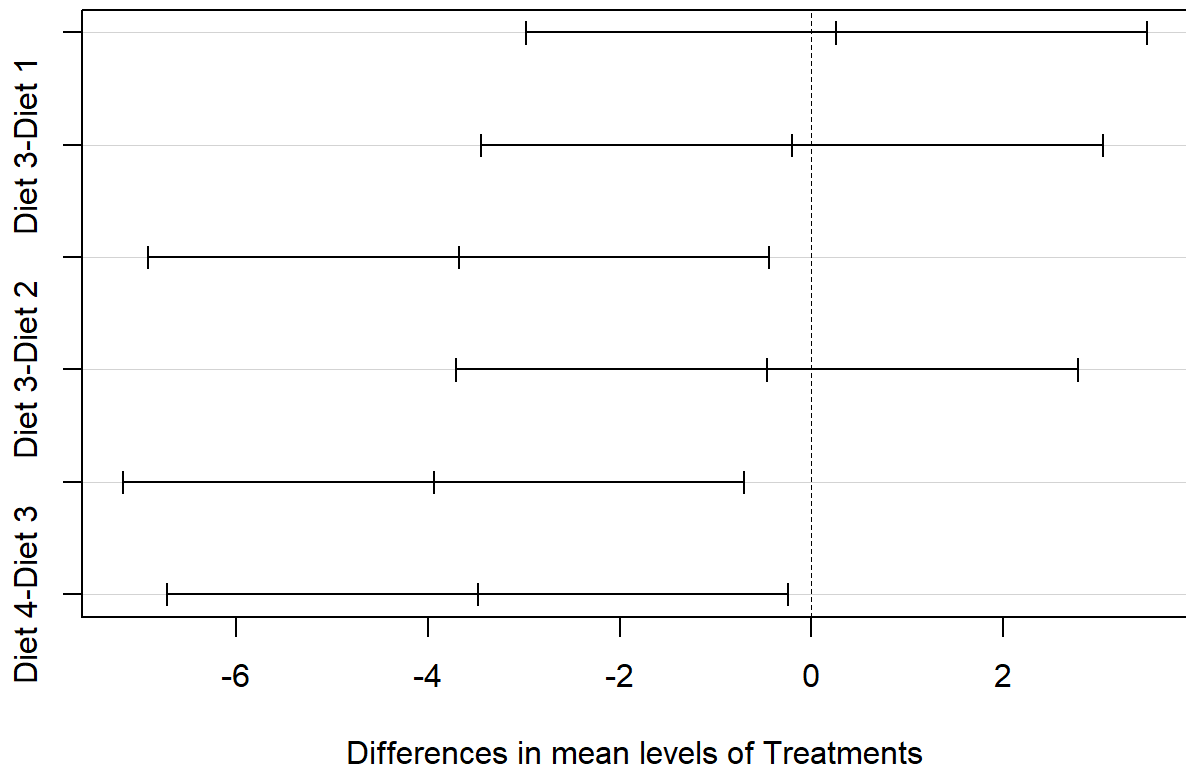
To perform Tukey's Test among the treatments (Diet), use the following code:

```
TukeyHSD(aov(Outcomes~Treatments, data = Block_data))
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = Outcomes ~ Treatments, data = Block_data)
##
## $Treatments
##          diff          lwr          upr          p adj
## Diet 2-Diet 1  0.26 -2.981171  3.5011706 0.9955631
## Diet 3-Diet 1 -0.20 -3.441171  3.0411706 0.9979611
## Diet 4-Diet 1 -3.68 -6.921171 -0.4388294 0.0234253
## Diet 3-Diet 2 -0.46 -3.701171  2.7811706 0.9766066
## Diet 4-Diet 2 -3.94 -7.181171 -0.6988294 0.0147876
## Diet 4-Diet 3 -3.48 -6.721171 -0.2388294 0.0332106
```

To plot the results of Tukey's Test, run the following code:

```
tukey <- TukeyHSD(aov(Outcomes~Treatments, data = Block_data))
plot(tukey)
```

## 95% family-wise confidence level



## Mosaic

Install the Mosaic package, if necessary, using the command

```
install.packages("mosaic")
```

```
## Warning: package 'mosaic' was built under R version 4.3.1
## Registered S3 method overwritten by 'mosaic':
##   method                from
##   fortify.SpatialPolygonsDataFrame ggplot2
##
## The 'mosaic' package masks several functions from core packages in order to add
## additional features. The original behavior of these functions should not be affect
## ed by this.
##
## Attaching package: 'mosaic'
## The following objects are masked from 'package:dplyr':
```

```
##
##   count, do, tally
## The following object is masked from 'package:Matrix':
##
##   mean
## The following object is masked from 'package:ggplot2':
##
##   stat
## The following objects are masked from 'package:stats':
##
##   binom.test, cor, cor.test, cov, fivenum, IQR, median, prop.test,
##   quantile, sd, t.test, var
## The following objects are masked from 'package:base':
##
##   max, mean, min, prod, range, sample, sum
```

For Mosaic, it is not necessary to use the `aov()` command to run Tukey's Test.

```
TukeyHSD(Outcomes~Treatments+Blocks,data=Block_data)$Treatments
##           diff      lwr      upr      p adj
## Diet 2-Diet 1  0.26 -3.020289  3.5402887 0.99516070
## Diet 3-Diet 1 -0.20 -3.480289  3.0802887 0.99777403
## Diet 4-Diet 1 -3.68 -6.960289 -0.3997113 0.02663379
## Diet 3-Diet 2 -0.46 -3.740289  2.8202887 0.97461370
## Diet 4-Diet 2 -3.94 -7.220289 -0.6597113 0.01763219
## Diet 4-Diet 3 -3.48 -6.760289 -0.1997113 0.03654080
```

To plot the results of Tukey's Test, run the following code.

```
tukey <- TukeyHSD(Outcomes~Treatments,data=Block_data)
mplot(tukey)
```

95% family-wise confidence level

