

How can I perform Dunnett's test in R to compare multiple treatments against a control group?

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Dunnett's test is a statistical method commonly used to compare multiple treatments against a control group in experimental studies. In order to perform this test in R, there are several steps that need to be followed. First, the data must be organized in a suitable format, with the control group as a separate column. Next, the Dunnett's test function must be loaded from the appropriate package, such as "multcomp". The function will require the input of the data, the control group column, and the desired significance level. Once the test is run, the results will provide a comparison of each treatment group against the control group, along with p-values and confidence intervals. This allows for a comprehensive analysis of the differences between the treatments and the control group. Overall, the Dunnett's test in R is a powerful tool for identifying significant differences between multiple treatments and a control group.

Perform Dunnett's Test in R

A **post-hoc test** is a type of test that is performed following an **ANOVA** to determine which group means are statistically significantly different from each other.

If one of the groups in the study is considered the ***control group***, then we should use **Dunnett's test** as the post-hoc test.

This tutorial explains how to perform Dunnett's test in R.

Example: Dunnett's Test in R

Suppose a teacher wants to know whether or not two new studying techniques have the potential to increase exam scores for her students. To test this, she randomly splits her class of 30 students into the

following three groups:

Control Group: 10 students
New Study technique 1: 10 students
New Study Technique 2: 10 students

After one week of using their assigned study technique, each student takes the same exam.

We can use the following steps in R to create a dataset, visualize the group means, perform a one-way ANOVA, and lastly perform Dunnett's test to determine which (if either) new studying technique produces different results compared to the control group.

Step 1: Create the dataset.

The following code shows how to create a dataset that contains exam scores for all 30 students:

```
#create data frame  
data <- data.frame(technique = rep(c("control", "new1",  
"new2"), each = 10),  
score = c(76, 77, 77, 81, 82, 82, 83, 84, 85, 89,  
81, 82, 83, 83, 83, 84, 87, 90, 92, 93,  
77, 78, 79, 88, 89, 90, 91, 95, 95, 98))
```

```
#view first six rows of data frame  
head(data)
```

```
technique score
```

```
1 control 76
```

```
2 control 77
```

```
3 control 77
```

```
4 control 81
```

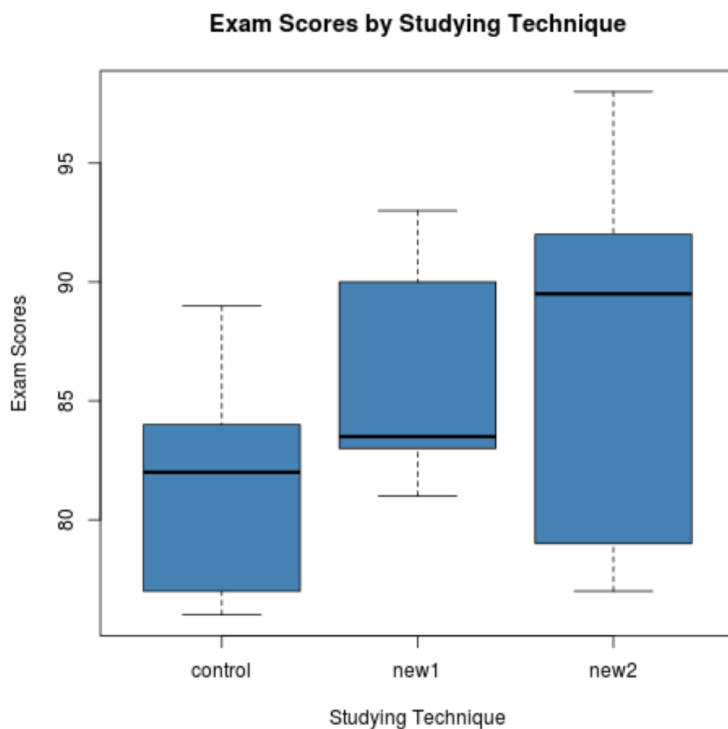
```
5 control 82
```

```
6 control 82
```

Step 2: Visualize the exam scores for each group.

The following code shows how to produce boxplots to visualize the distribution of exam scores for each group:

```
boxplot(score ~ technique,  
data = data,  
main = "Exam Scores by Studying Technique",  
xlab = "Studying Technique",  
ylab = "Exam Scores",  
col = "steelblue",  
border = "black")
```



Just from the boxplots we can see that the distribution of exam scores is quite different for each studying technique. Next, we'll perform a one-way ANOVA to determine if these differences are statistically significant.

How to Plot Multiple Boxplots in One Chart in R

The following code shows how to perform a one-way ANOVA to test for differences among mean exam scores in each group:

```
#fit the one-way ANOVA model
```

```
model <- aov(score ~ technique, data = data)
```

```
#view model output
```

```
summary(model)
```

```
Df Sum Sq Mean Sq F value Pr(>F)
technique 2 211.5 105.73 3.415 0.0476 *
Residuals 27 836.0 30.96
```

```
---
```

```
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Since the overall p-value (0.0476) is less than .05, this is an indication that each group does not have the same average exam score. Next, we will perform Dunnett's Test to determine which studying technique produces mean exam scores that differ from the control group.

Step 4: Perform Dunnett's Test.

To perform Dunnett's Test in R we can use the `DunnettTest()` function from the `DescTools` library which uses the following syntax:

```
DunnettTest(x, g)
```

where:

x: A numeric vector of data values (e.g. exam scores)
g: A vector that specifies the group names (e.g. studying technique)

The following code shows how to use this function for our example:

```
#load DescTools library  
library(DescTools)
```

```
#perform Dunnett's Test  
DunnettTest(x=data$score, g=data$technique)
```

Dunnett's test for comparing several treatments with a control :
 95% family-wise confidence level

```
$control  
diff lwr.ci upr.ci pval  
new1-control 4.2 -1.6071876 10.00719 0.1787  
new2-control 6.4 0.5928124 12.20719 0.0296 *
```

```
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.0  
' 1
```

The way to interpret the output is as follows:

The mean difference in exam scores between the new studying technique 1 and the control group is 4.2 The corresponding p-value is 0.1787. The mean difference in exam scores between the new studying technique 2 and the control group is 6.4 The corresponding p-value is 0.0296.

Based on the output, we can see that studying technique 2 is the only technique that produces significantly ($p = .0296$) different mean exam scores compared to the control group.

[An Introduction to the One-Way ANOVA](#)

[How to Conduct a One-Way ANOVA in R](#)

[How to Perform Tukey's Test in R](#)