

PlantGrowth_ExperimentalDesign

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Introduction

The **PlantGrowth** dataset contains results from an experiment comparing the effect of different treatments on plant weight.

There are three groups: - **ctrl**: Control group

- **trt1**: Treatment 1

- **trt2**: Treatment 2

The dataset has 30 observations.

```
data(PlantGrowth) boxplot(weight ~ group, data=PlantGrowth, main="Plant Growth by Group")
```

View dataset

```
head(PlantGrowth)
```

```
##   weight group
## 1   4.17  ctrl
## 2   5.58  ctrl
## 3   5.18  ctrl
## 4   6.11  ctrl
## 5   4.50  ctrl
## 6   4.61  ctrl
```

```
summary(PlantGrowth)
```

```
##      weight      group
##  Min.    :3.590  ctrl:10
##  1st Qu.:4.550  trt1:10
##  Median :5.155  trt2:10
##  Mean    :5.073
##  3rd Qu.:5.530
##  Max.    :6.310
```

```
table(PlantGrowth$group)
```

```
##
## ctrl trt1 trt2
##   10   10   10
```

Descriptive Statistics

```
install.packages("dplyr", repos = "https://cloud.r-project.org")
```

```
## Installing package into 'C:/Users/dkvh2/AppData/Local/R/win-library/4.5'
## (as 'lib' is unspecified)

## package 'dplyr' successfully unpacked and MD5 sums checked

## Warning: cannot remove prior installation of package 'dplyr'

## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem copying
## C:\Users\dkvh2\AppData\Local\R\win-library\4.5\00LOCK\dplyr\libs\x64\dplyr.dll
## to C:\Users\dkvh2\AppData\Local\R\win-library\4.5\dplyr\libs\x64\dplyr.dll:
## Permission denied

## Warning: restored 'dplyr'

##
## The downloaded binary packages are in
## C:\Users\dkvh2\AppData\Local\Temp\RtmpmOMPKQ\downloaded_packages
```

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union
```

```
install.packages("ggplot2", repos = "https://cloud.r-project.org")
```

```
## Installing package into 'C:/Users/dkvh2/AppData/Local/R/win-library/4.5'
## (as 'lib' is unspecified)

## package 'ggplot2' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
## C:\Users\dkvh2\AppData\Local\Temp\RtmpmOMPKQ\downloaded_packages
```

```
library(ggplot2)

PlantGrowth %>%
  group_by(group) %>%
  summarise(
    mean_weight = mean(weight),
    sd_weight = sd(weight),
    n = n()
  )
```

```
## # A tibble: 3 x 4
##   group mean_weight sd_weight    n
##   <fct>      <dbl>    <dbl> <int>
## 1 ctrl         5.03      0.583    10
## 2 trt1         4.66      0.794    10
## 3 trt2         5.53      0.443    10
```

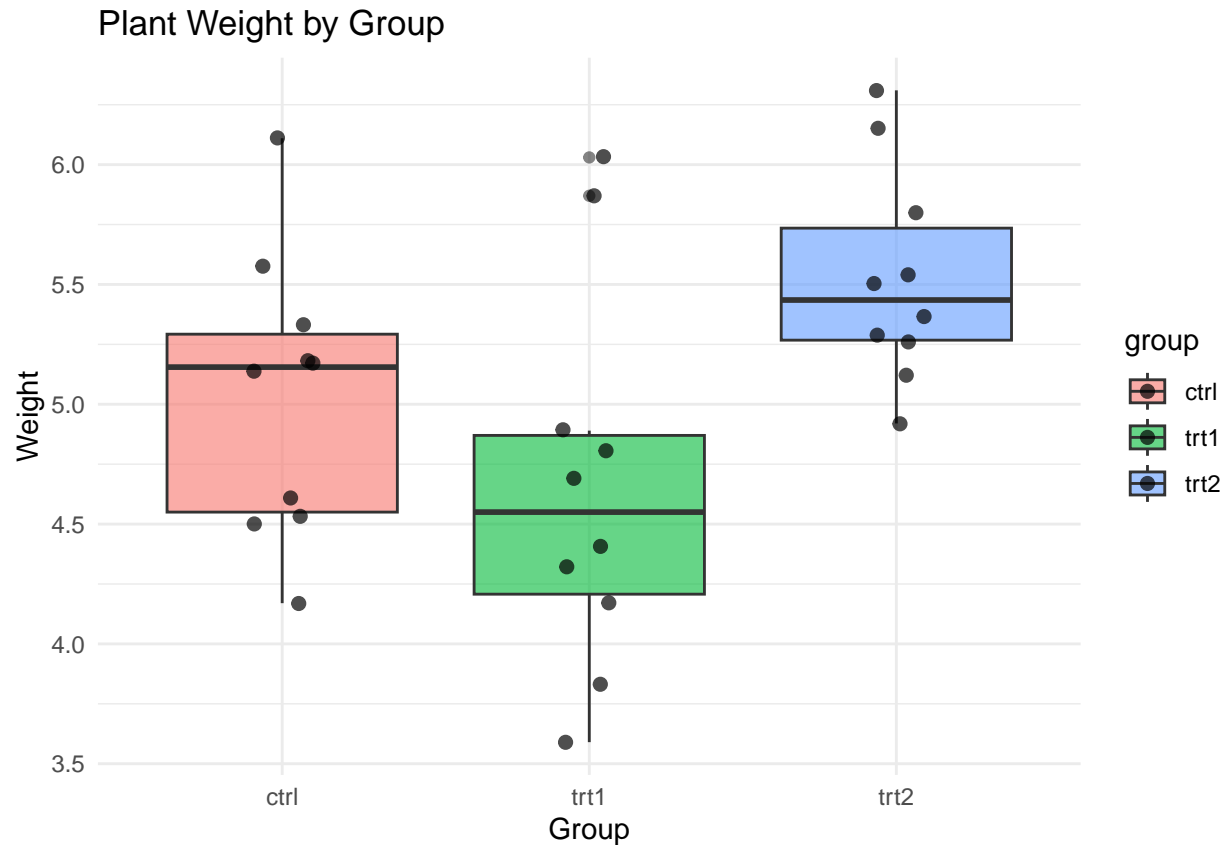
Boxplot with jittered Points

```
install.packages("ggplot2", repos = "https://cloud.r-project.org")
```

```
## Warning: package 'ggplot2' is in use and will not be installed
```

```
library(ggplot2)

ggplot(PlantGrowth, aes(x = group, y = weight, fill = group)) +
  geom_boxplot(alpha = 0.6) +
  geom_jitter(width = 0.1, size = 2, alpha = 0.7) +
  labs(title = "Plant Weight by Group",
       x = "Group",
       y = "Weight") +
  theme_minimal()
```



Mean Plot with Error Bars

```
install.packages("dplyr", repos = "https://cloud.r-project.org")
```

```
## Warning: package 'dplyr' is in use and will not be installed
```

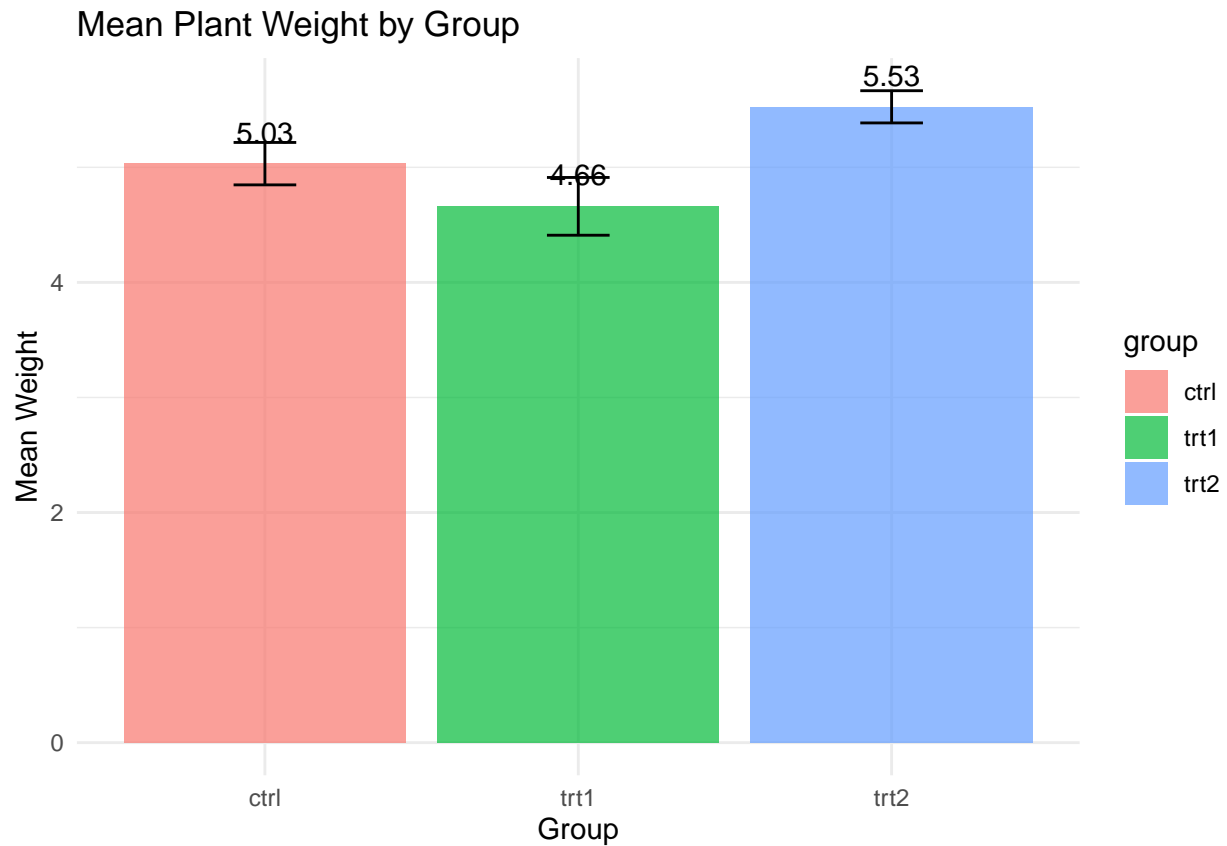
```
library(ggplot2)
install.packages("ggplot2", repos = "https://cloud.r-project.org")
```

```
## Warning: package 'ggplot2' is in use and will not be installed
```

```
library(dplyr)

stats <- PlantGrowth %>%
  group_by(group) %>%
  summarise(
    mean_weight = mean(weight),
    se = sd(weight) / sqrt(n())
  )
ggplot(stats, aes(x = group, y = mean_weight, fill = group)) +
  geom_col(alpha = 0.7) +
```

```
geom_errorbar(aes(ymin = mean_weight - se, ymax = mean_weight + se),
              width = 0.2, color = "black") +
geom_text(aes(label = round(mean_weight, 2)), vjust = -1) +
labs(title = "Mean Plant Weight by Group",
     x = "Group",
     y = "Mean Weight") +
theme_minimal()
```



ANOVA

```
model <- aov(weight ~ group, data=PlantGrowth)
summary(model)
```

```
##           Df Sum Sq Mean Sq F value Pr(>F)
## group      2  3.766   1.8832   4.846 0.0159 *
## Residuals 27 10.492   0.3886
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Post-hoc test

```
TukeyHSD(model)
```

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = weight ~ group, data = PlantGrowth)
##
## $group
##          diff          lwr          upr          p adj
## trt1-ctrl -0.371 -1.0622161 0.3202161 0.3908711
## trt2-ctrl 0.494 -0.1972161 1.1852161 0.1979960
## trt2-trt1 0.865 0.1737839 1.5562161 0.0120064
```

Violin Plot

```
ggplot(PlantGrowth, aes(x = group, y = weight, fill = group)) +
  geom_violin(trim = FALSE, alpha = 0.6) +
  geom_boxplot(width = 0.1, fill = "white") +
  labs(title = "Distribution of Plant Weights by Group",
       x = "Group",
       y = "Weight") +
  theme_minimal()
```

