FA8

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```
# Load the PlantGrowth dataset
data("PlantGrowth")

# View the structure and summary of the data
str(PlantGrowth)
```

```
## 'data.frame':    30 obs. of  2 variables:
##  $ weight: num  4.17 5.58 5.18 6.11 4.5 4.61 5.17 4.53 5.33 5.14 ...
##  $ group : Factor w/ 3 levels "ctrl","trt1",..: 1 1 1 1 1 1 1 1 1 1 ...
```

```
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
```

The dataset has two variables:

- weight: Numeric variable representing plant weight.
- group: Factor variable with three levels: ctrl (control), trt1 (treatment 1), and trt2 (treatment 2).

Descriptive Statistics

- Calculate descriptive statistics (mean and standard deviation) for each group.

```
# Load necessary library for descriptive statistics
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
```

```
# Calculate descriptive statistics
descriptive_stats <- PlantGrowth %>%
  group_by(group) %>%
  summarise(
    Mean = mean(weight),
    SD = sd(weight),
    N = n()
  )

print(descriptive_stats)
```

```
## # A tibble: 3 × 4
##   group  Mean    SD     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
```

One-Way ANOVA

- Conduct a one-way ANOVA to examine whether there is a significant difference in plant weights across the treatment groups.

Null Hypothesis (H0)

- There is no significant difference in plant weight between the treatment groups.

```
# Perform the one-way ANOVA
anova_model <- aov(weight ~ group, data = PlantGrowth)

# Output the ANOVA table
summary(anova_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 (if ANOVA is significant)

- If the ANOVA is significant, perform a Tukey's HSD post-hoc test to identify where the differences lie.

```
# Tukey's HSD test for multiple comparisons
tukey_test <- TukeyHSD(anova_model)

# Output the results
print(tukey_test)
```

```
##   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
```

Checking Assumptions

- Normality: Check the normality of residuals with the Shapiro-Wilk test and Q-Q plot.
- Homogeneity of Variances: Use Levene's test to check homogeneity of variances.

```
# Check normality of residuals
shapiro_test <- shapiro.test(residuals(anova_model))

# Load car package for Levene's test
library(car)
```

```
## Loading required package: carData
```

```
##
## Attaching package: 'car'
```

```
## The following object is masked from 'package:dplyr':
##
##     recode
```

```
# Perform Levene's test
levene_test <- leveneTest(weight ~ group, data = PlantGrowth)

# Output the results
print(shapiro_test)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  residuals(anova_model)
## W = 0.96607, p-value = 0.4379
```

```
print(levene_test)
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##       Df F value Pr(>F)
## group  2  1.1192 0.3412
##       27
```

Report

Abstract

This study examined whether there were significant differences in plant weight among three treatment groups (control, treatment 1, and treatment 2) using data from the PlantGrowth dataset. A one-way ANOVA was conducted, revealing a statistically significant difference in plant weights between groups. Post-hoc comparisons indicated that the significant difference was specifically between treatment groups 1 and 2.

Method

Participants

The PlantGrowth dataset contains 30 observations of plant weights, categorized into three treatment groups with 10 observations each: ctrl (control), trt1 (treatment 1), and trt2 (treatment 2).

Descriptive Statistics

Descriptive statistics indicated that the control group had a mean weight of 5.03 (SD = 0.583), treatment 1 had a mean weight of 4.66 (SD = 0.794), and treatment 2 had a mean weight of 5.53 (SD = 0.443).

Statistical Analysis

A one-way ANOVA was conducted to determine if there were significant differences in plant weight between the three groups. The assumptions of normality and homogeneity of variance were checked and met, as indicated by the Shapiro-Wilk test of residuals ($W = 0.966$, $p = 0.438$) and Levene's test ($F(2, 27) = 1.119$, $p = 0.341$).

Results

The results of the one-way ANOVA indicated a significant effect of group on plant weight, $F(2, 27) = 4.846$, $p = 0.016$. Post-hoc analysis using Tukey's HSD test revealed a statistically significant difference between treatment 1 and treatment 2 (Mdiff = 0.865, p = 0.012), but not between the control and treatment groups (trt1-ctrl: Mdiff = -0.371, p = 0.391; trt2-ctrl: Mdiff = 0.494, p = 0.198).

Assumptions

The assumption of normality was satisfied (Shapiro-Wilk $W = 0.966$, $p = 0.438$), and Levene's test confirmed homogeneity of variances among groups, $F(2, 27) = 1.119$, $p = 0.341$.

Discussion

The one-way ANOVA results indicate that there is a statistically significant difference in plant weight between the treatment groups. Specifically, the Tukey post-hoc test showed that the significant difference lies between treatment 1 and treatment 2, with treatment 2 having a higher mean weight. This suggests that the treatment applied in treatment group 2 may have a positive effect on plant growth relative to treatment 1.

Conclusion

In conclusion, this analysis provides evidence that treatment group 2 differs significantly from treatment 1 in terms of plant weight, indicating a potential impact of the treatment on growth. Further research might explore different dosage levels or environmental conditions to confirm these findings.