Rat Exploration Dataset

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Item no. 14

```r
library(tidyverse)
library(broom)  # For tidy output

# Import the Excel file
file_path <- file.choose()  # Select your file
df <- read_csv(file_path)

# Check the data structure
head(df)
```

```
## # A tibble: 6 x 4
##      ID Stimuli  Time ...4
##   <dbl> <chr>   <dbl> <lgl>
## 1     1 Shape    2    NA
## 2     2 Shape    0.75 NA
## 3     3 Shape    1.25 NA
## 4     4 Shape    1    NA
## 5     5 Shape    1.5  NA
## 6     6 Shape    1.25 NA
```

```r
#I.
# Perform one-way ANOVA
anova_results <- aov(Time ~ Stimuli, data = df)

# View the ANOVA table
summary(anova_results)
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Stimuli      2  44.53  22.263   62.09 6.53e-12 ***
## Residuals   33  11.83   0.359
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# Shapiro-Wilk test
shapiro_test <- shapiro.test(df$Time)
print(shapiro_test)
```

```
##
##  Shapiro-Wilk normality test
```

```
##
## data:  df$Time
## W = 0.95005, p-value = 0.105
```

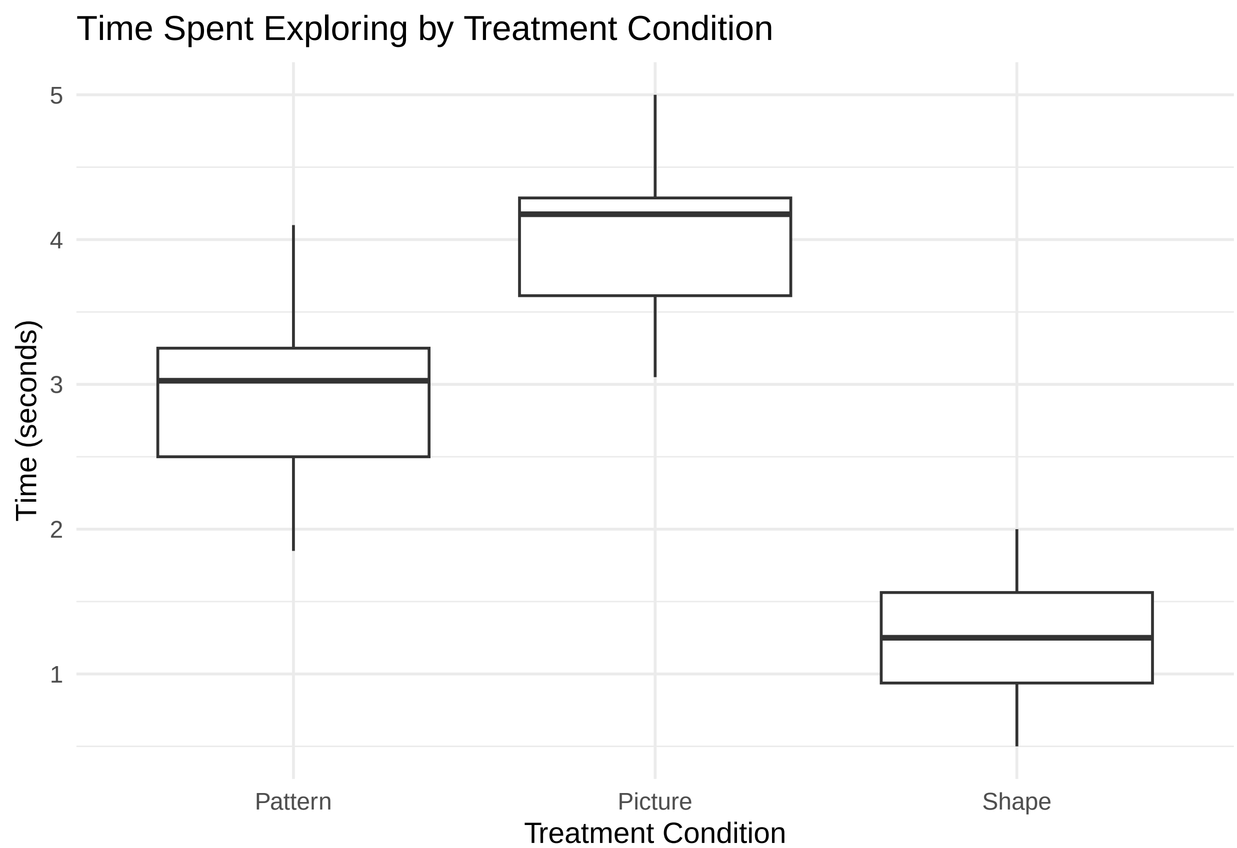
```r
library(car)

# Levene's test
levene_test <- leveneTest(Time ~ Stimuli, data = df)
print(levene_test)
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##       Df F value Pr(>F)
## group  2  0.4313 0.6533
##       33
```

```r
# Post-hoc test if ANOVA is significant
post_hoc <- TukeyHSD(anova_results)
print(post_hoc)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Time ~ Stimuli, data = df)
##
## $Stimuli
##                      diff        lwr       upr     p adj
## Picture-Pattern  1.066667  0.4668045  1.666529 0.0003414
## Shape-Pattern   -1.637500 -2.2373622 -1.037638 0.0000004
## Shape-Picture   -2.704167 -3.3040289 -2.104304 0.0000000
```

```r
# Boxplot of Time by Stimuli
ggplot(df, aes(x = Stimuli, y = Time)) +
  geom_boxplot() +
  labs(title = "Time Spent Exploring by Treatment Condition",
       x = "Treatment Condition",
       y = "Time (seconds)") +
  theme_minimal()
```




```r
# Print summarized results
cat("Summary of Results:\n")
```

```
## Summary of Results:
```

```r
cat("\nOne-Way ANOVA:\n")
```

```
##
## One-Way ANOVA:
```

```r
anova_summary <- summary(anova_results)
print(anova_summary)
```

```
##             Df Sum Sq Mean Sq F value   Pr(>F)
## Stimuli      2  44.53  22.263   62.09 6.53e-12 ***
## Residuals   33  11.83   0.359
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
cat("\nShapiro-Wilk Test:\n")
```

```
##
## Shapiro-Wilk Test:
```

```r
cat(sprintf("Statistic = %.4f, p-value = %.4f\n", shapiro_test$statistic, shapiro_test$p.value))
```

```
## Statistic = 0.9501, p-value = 0.1050
```

```r
cat("\nLevene's Test for Homogeneity of Variance:\n")
```

```
##
## Levene's Test for Homogeneity of Variance:
```

```r
cat(sprintf("Statistic = %.4f, p-value = %.4f\n", levene_test$statistic, levene_test$p.value))

cat("\nPost-Hoc Test (Tukey's HSD):\n")
```

```
##
## Post-Hoc Test (Tukey's HSD):
```

```r
print(post_hoc)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Time ~ Stimuli, data = df)
##
## $Stimuli
##                      diff        lwr       upr     p adj
## Picture-Pattern  1.066667  0.4668045  1.666529 0.0003414
## Shape-Pattern   -1.637500 -2.2373622 -1.037638 0.0000004
## Shape-Picture   -2.704167 -3.3040289 -2.104304 0.0000000
```

```r
#2
# Shapiro-Wilk test for normality for each group
shapiro_test_shape <- shapiro.test(df$Time[df$Stimuli == "Shape"])
shapiro_test_pattern <- shapiro.test(df$Time[df$Stimuli == "Pattern"])
shapiro_test_picture <- shapiro.test(df$Time[df$Stimuli == "Picture"])

# Print Shapiro-Wilk test results
cat("Shapiro-Wilk Test Results:\n")
```

```
## Shapiro-Wilk Test Results:
```

```r
print(shapiro_test_shape)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  df$Time[df$Stimuli == "Shape"]
## W = 0.94374, p-value = 0.548
```

```r
print(shapiro_test_pattern)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  df$Time[df$Stimuli == "Pattern"]
## W = 0.95005, p-value = 0.6377
```

```r
print(shapiro_test_picture)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  df$Time[df$Stimuli == "Picture"]
## W = 0.91516, p-value = 0.2483
```

```r
# Levene's test for homogeneity of variances
levene_test <- leveneTest(Time ~ Stimuli, data = df)
cat("\nLevene's Test for Homogeneity of Variances:\n")
```

```
##
## Levene's Test for Homogeneity of Variances:
```

```r
print(levene_test)
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##       Df F value Pr(>F)
## group  2  0.4313 0.6533
##       33
```

1. Interpretation of the Results

Overall Structure:

The output shows the differences between the mean exploration times for each pair of treatment conditions, along with the lower and upper bounds of the confidence interval for the mean difference and the adjusted p-values.

Mean Differences:

Picture vs. Pattern:

- Difference: 1.066667 seconds
- Confidence Interval: (0.4668045, 1.666529)
- Adjusted p-value: 0.0003414
- Interpretation: The rats spent significantly more time exploring the chamber when shown pictures compared to patterns. The difference of about 1.07 seconds is statistically significant ($p < 0.001$).

Shape vs. Pattern:

- Difference: -1.637500 seconds
- Confidence Interval: (-2.2373622, -1.037638)
- Adjusted p-value: 0.0000004
- Interpretation: The rats spent significantly less time exploring the chamber when shown shapes compared to patterns. The difference of about 1.64 seconds is statistically significant ($p < 0.001$).

Shape vs. Picture:

- Difference: -2.704167 seconds
- Confidence Interval: (-3.3040289, -2.104304)
- Adjusted p-value: 0.0000000
- Interpretation: The rats spent significantly less time exploring the chamber when shown shapes compared to pictures. The difference of about 2.70 seconds is statistically significant ($p < 0.001$).

Summary of Findings:

The analysis indicates that:

Pictures significantly increased exploration time compared to both Patterns and Shapes. Shapes resulted in significantly less exploration time compared to both Patterns and Pictures. Patterns led to an intermediate level of exploration time, significantly different from both other conditions.

Conclusion:

Overall, the results suggest that the type of visual stimuli significantly affects the exploration behavior of the rats, with pictures promoting more exploration compared to shapes and patterns. The Tukey's HSD test confirms these differences with statistically significant p-values for all pairwise comparisons.

2. Shapiro-Wilk Test Results:

Shape Group:

W = 0.94374, p-value = 0.548 **Interpretation:** The p-value is greater than 0.05, which indicates that we fail to reject the null hypothesis. This suggests that the data for the "Shape" group is normally distributed.

Pattern Group:

W = 0.95005, p-value = 0.6377 Interpretation: Again, the p-value is greater than 0.05. Thus, we fail to reject the null hypothesis, indicating that the data for the "Pattern" group is also normally distributed.

Picture Group:

W = 0.91516, p-value = 0.2483 Interpretation: The p-value here is also greater than 0.05, meaning we fail to reject the null hypothesis. This indicates that the data for the "Picture" group is normally distributed as well. Overall Conclusion for Normality Tests: All three treatment groups (Shape, Pattern, and Picture) show normal distribution of the time spent exploring, as indicated by the p-values from the Shapiro-Wilk tests. This suggests that the assumption of normality is satisfied for the one-way ANOVA.

Levene's Test for Homogeneity of Variances:

Levene's Test Output:

Df: 2 (degrees of freedom for the groups) F value = 0.4313 p-value = 0.6533 Interpretation: The p-value of 0.6533 is much greater than 0.05. This indicates that we fail to reject the null hypothesis of equal variances. Therefore, we can conclude that the variances among the three groups (Shape, Pattern, and Picture) are homogenous, meaning they are approximately equal.

Overall Conclusion for Variance Homogeneity:

The assumption of homogeneity of variances is satisfied, which is necessary for conducting a one-way ANOVA.

Summary:

All groups meet the assumption of normality. The variances across the groups are equal. Therefore, the assumptions for performing a one-way ANOVA are met, and you can confidently proceed with the ANOVA analysis to compare the time spent exploring the chamber among the three treatment conditions.