Analysis of NFL Concentrations Across Dosage Groups

Task 3

September 14, 2025

CM2018 HT25 Statistics for Medical Engineering

Introduction

- Overview of the study: Analysis of NfL (Neurofilament Light) concentrations in a group of healthy volunteers.
- Purpose: To compare NfL concentrations across four dosage groups: Low, Control, Medium, and High.
- Data collection method: Read from Data_T3.csv file.

Methodology & Assumptions

We have data divided as 20 patients per study (total 80) as the sample size is low usage of non-parametertic techniques are to be preferred and multi group statistical tests are to be utilized.

We make the following assumption

- The data for each group are samples originate from the same distribution.
- We assume the data to be normally distributed.

Methodology

- Data exploration:
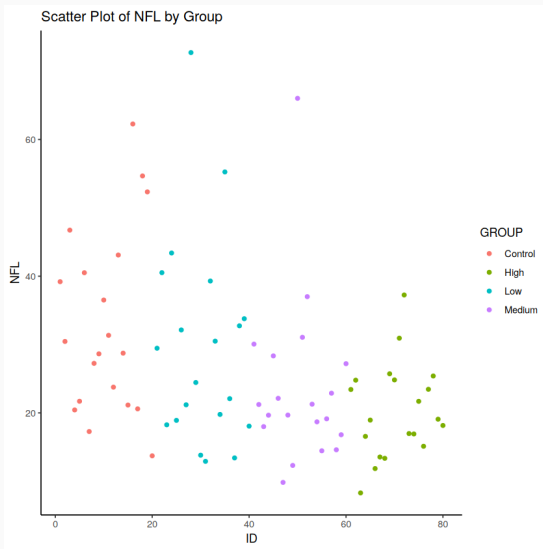 - Histograms and QQ plots to assess normality.
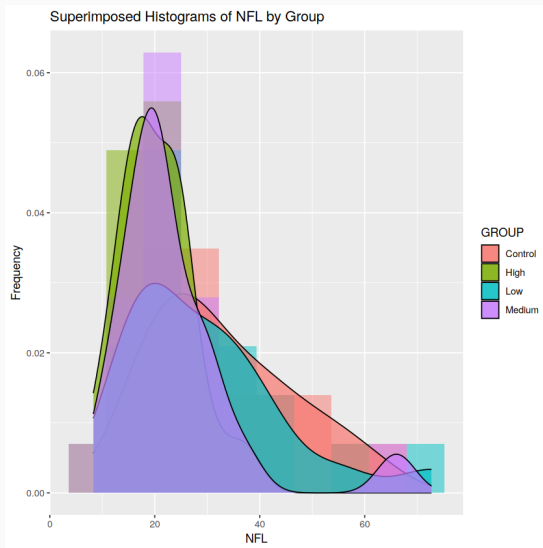- Statistical tests performed:
  Group Tests
  - Kruskal-Wallis test for overall comparison across groups to check if they are sampled from the same distribution.
  - Conover-Iman test for cross comparison across groups to for median differences.
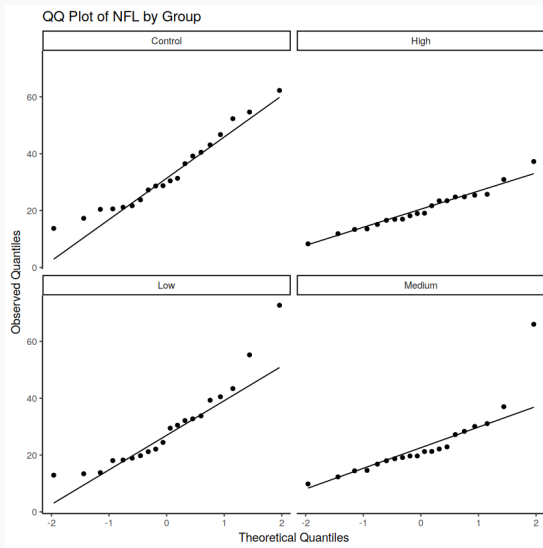
Data Visuals

Scatter Plot

Scatter Plot of NFL by Group

Histogram

QQ Plots

QQ Plot of NFL by Group

Histograms and QQ plots were plotted to assess normality.

- We make our first assumption of Control & High dosage group to be following normal distribution, as the variation is reasonable w.r.t. to the normal line.
- Vice versa we assume Low & Medium to be non-normal distribution, due to the high variance observed.

We shall use statistical tests to prove our assumptions

Kruskal-Wallis Test Results

1. Kruskal-Wallis test was performed to compare NFL concentrations across all groups:
   - H = 12.64, df = 3, p-value = 0.005483 ($p < 0.01$) Key Implications:
2. Significant difference in NFL concentrations between the different groups.
3. Data for each group have been sampled from different distributions.
4. As our previous assumption is untrue that would also mean that not all the groups are normal.
   Now we will use Conover–Iman test to do pairwise comparision. It is based on Kruskal-Wallis test.

Conover-Iman Test Results

The Conover-Iman test likewise preserves the ranks that the Kruskal-Wallis uses, and uses a pooled variance estimate to construct post hoc t test statistics.

1. Conover test was performed to compare NFL concentrations across all groups:
   - Kruskal-Wallis chi-squared = 12.64, df = 3, p-value = 0.01
2. Multiple comparisons of each group:

	Control	High	Low
High	0.0005*	-	-
Low	0.1375	0.0112*	-
Medium	0.0040*	0.2411	0.0543

3. Key Implications: Significant difference in NFL concentrations between the different groups.

Results

1. From the p-values we can observe that there is significant p values for Control vs High group = 0.0005 & Medium vs Control = 0.004.

2. There is also a very significant correlation between Medium vs High but is irrelevant to our testing.

3. The groups are not distributed normally or sampled from same distribution.

4. The dosage **MECAS-123** is only significant for High and Medium dosage and shows an improvement in reduced NfL levels.

- For High dosage 12.7037 pg/mL mean reduction. (Significant)
- For Medium dosage 9.49985 pg/mL mean reduction. (Significant)
- For Low dosage 3.38745 pg/mL mean reduction. (Insignificant)

The End

Questions? Comments?