Analysis of NFL Concentrations Across Dosage Groups

Task 3

September 10, 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

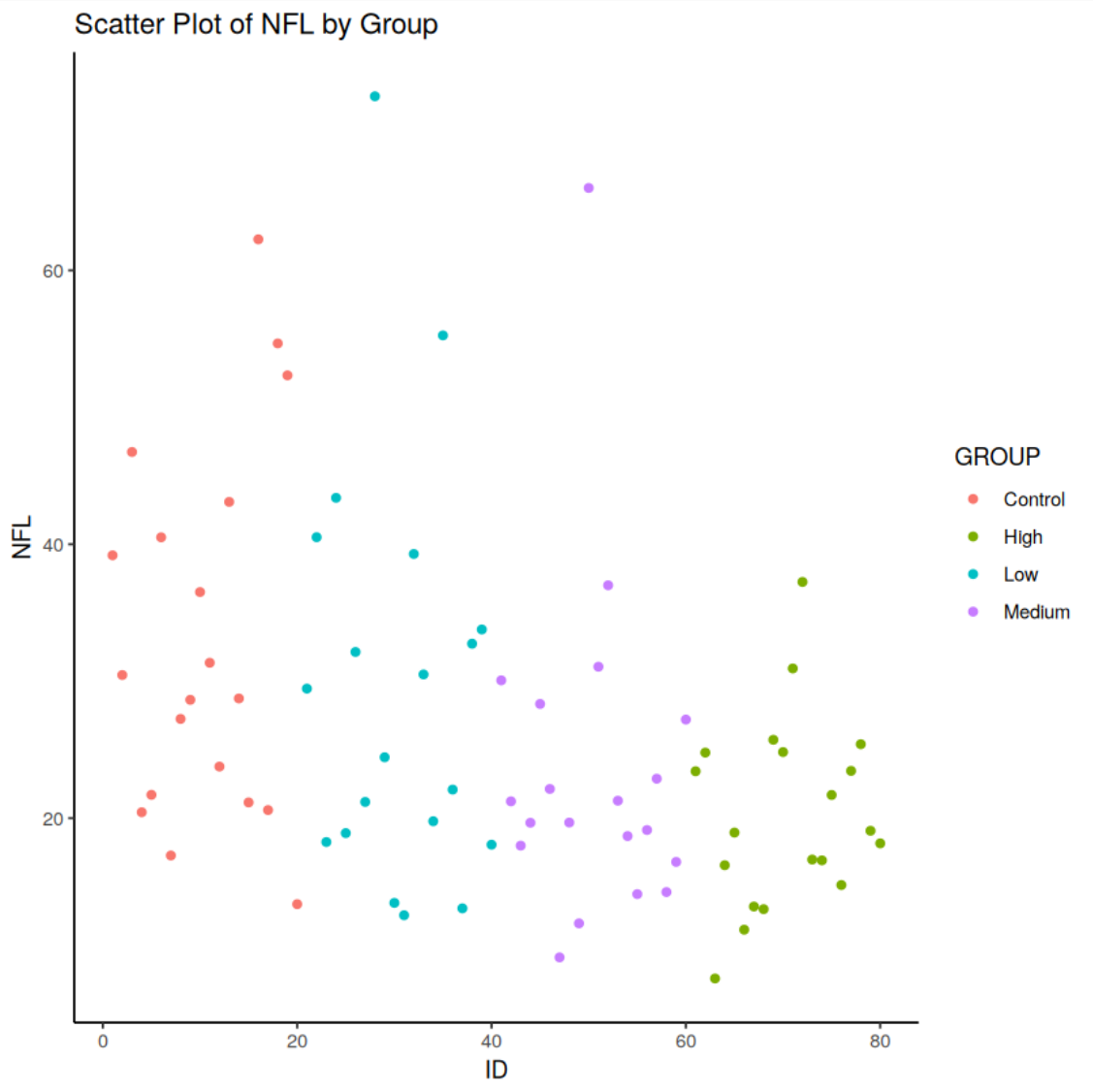
- Data exploration:
  - Histograms and QQ plots to assess normality.
- Statistical tests performed:

  Individual Tests
  - Shapiro-Wilk normality test for normal distribution assumption.
  - Wilcoxon-Mann-Whitney U-test for pairwise comparisons (non-parametric).

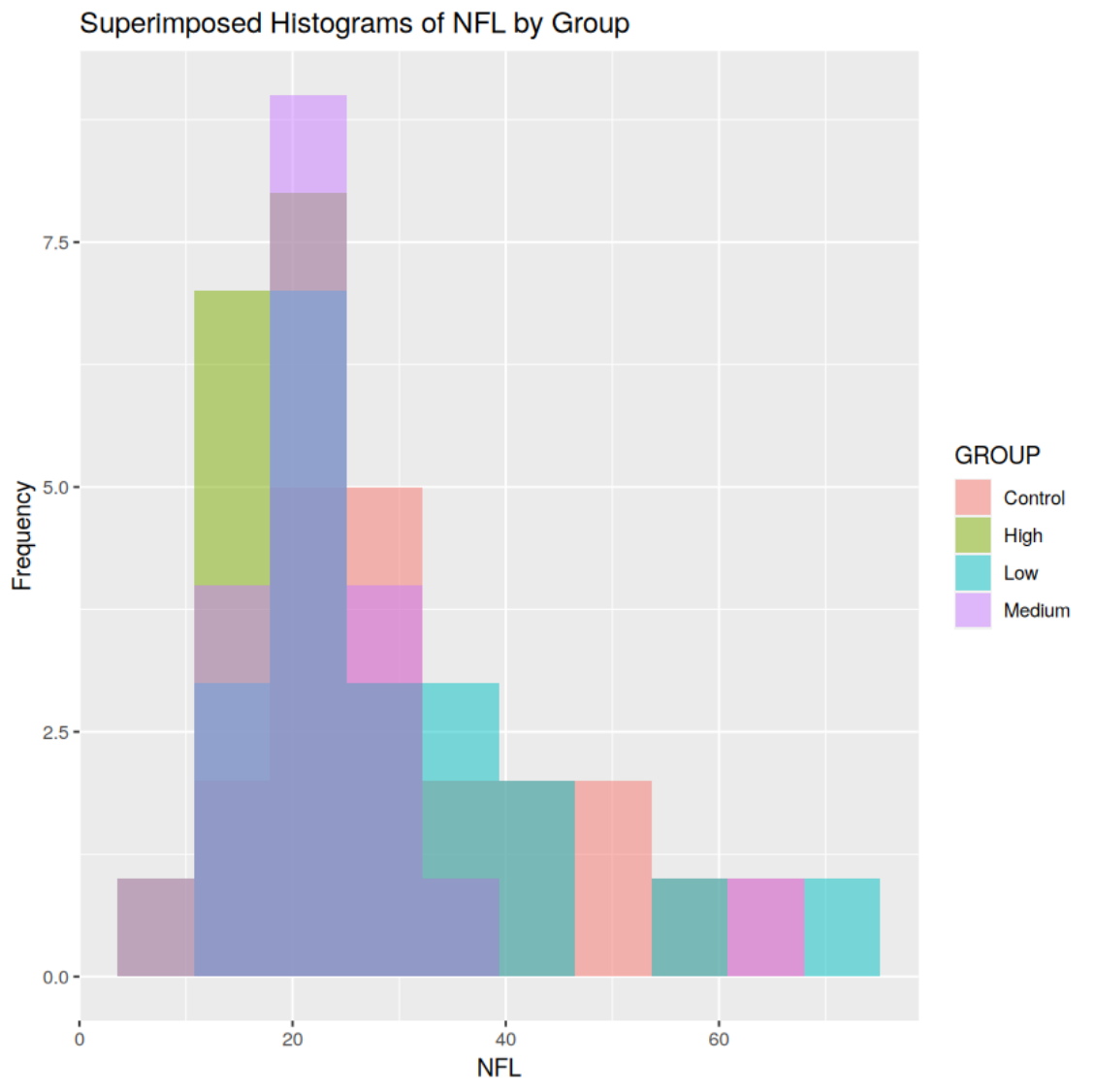
  Group Tests
  - Kruskal-Wallis test for overall comparison across groups.
  - Conover-Iman test for cross comparison across groups.

Data Visuals

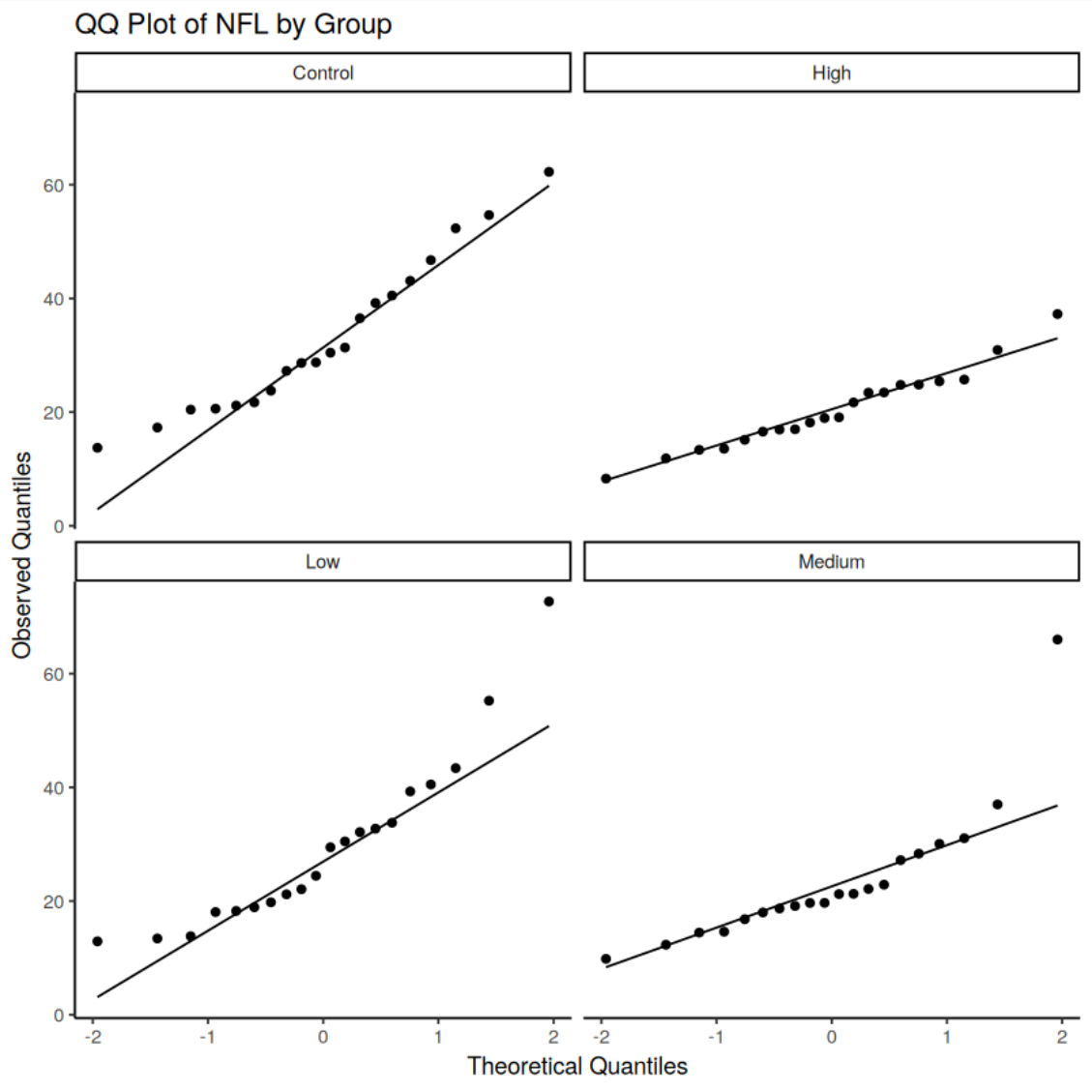
Scatter Plot



Histogram


Superimposed Histograms of NFL by Group
Frequency
7.5
5.0
2.5
0.0
0
20
40
60
NFL
GROUP
Control
High
Low
Medium

QQ Plots


QQ Plot of NFL by Group
Control
High
Low
Medium
Observed Quantiles
Theoretical Quantiles
0
20
40
60
-2
-1
0
1
2

Observations

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

Normality Test Results for NFL Concentrations

1. Shapiro-Wilk Normality Test was performed on each group:
   - Control: W = 0.9449 (p = 0.2974), PASS to Reject null hypothesis
   - High: W = 0.9676 (p = 0.7035), PASS to Reject null hypothesis
   - Low: W = 0.8813 (p = 0.0187), FAIL to Reject null hypothesis
   - Medium: W = 0.7638 (p = 2.27e-4), FAIL to Reject null hypothesis
2. Key Implications: Non-normality in the Low and Medium groups may impact the validity of statistical analyses relying on normal distribution assumptions.

Wilcoxon-Mann-Whitney Test Results

1. Wilcoxon-Mann-Whitney test was performed to compare NFL concentrations between each group and the Control group:
   - Low vs. Control: W = 168, p-value = 0.3983, FAIL to Reject null hypothesis
   - Medium vs. Control: W = 104, p-value = 0.008712, PASS to Reject null hypothesis
   - High vs. Control: W = 79, p-value = 0.0007474, PASS to Reject null hypothesis
2. Key Implications: NFL concentrations are significantly different in the Medium and High groups compared to the Control group.
   However, there is no significant difference between the Low group and the Control group.

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 ($p < 0.01$)
2. Key Implications: Significant difference in NFL concentrations between the different groups. The distribution of NFL concentrations is not the same across all groups.

Conover-Iman Test Results

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. Specifically, the Control group has significantly higher NFL concentrations than the High and Medium groups.

The End

Questions? Comments?