Course Capstone Project

Lytemar

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Introduction

The data set that we will analyze is the opening response time (ms) of an electromechanical valve. The valve controls the flow of several fluids where the opening and closing is actuated by a solenoid. The shutoff seal is an elastomer that is attached to the end of the solenoid plunger. In this project, we will determine how the seal vintage, fluid and applied coil voltage affects the valve's opening response time.

Exploratory Data Analysis

The summary of the data set is

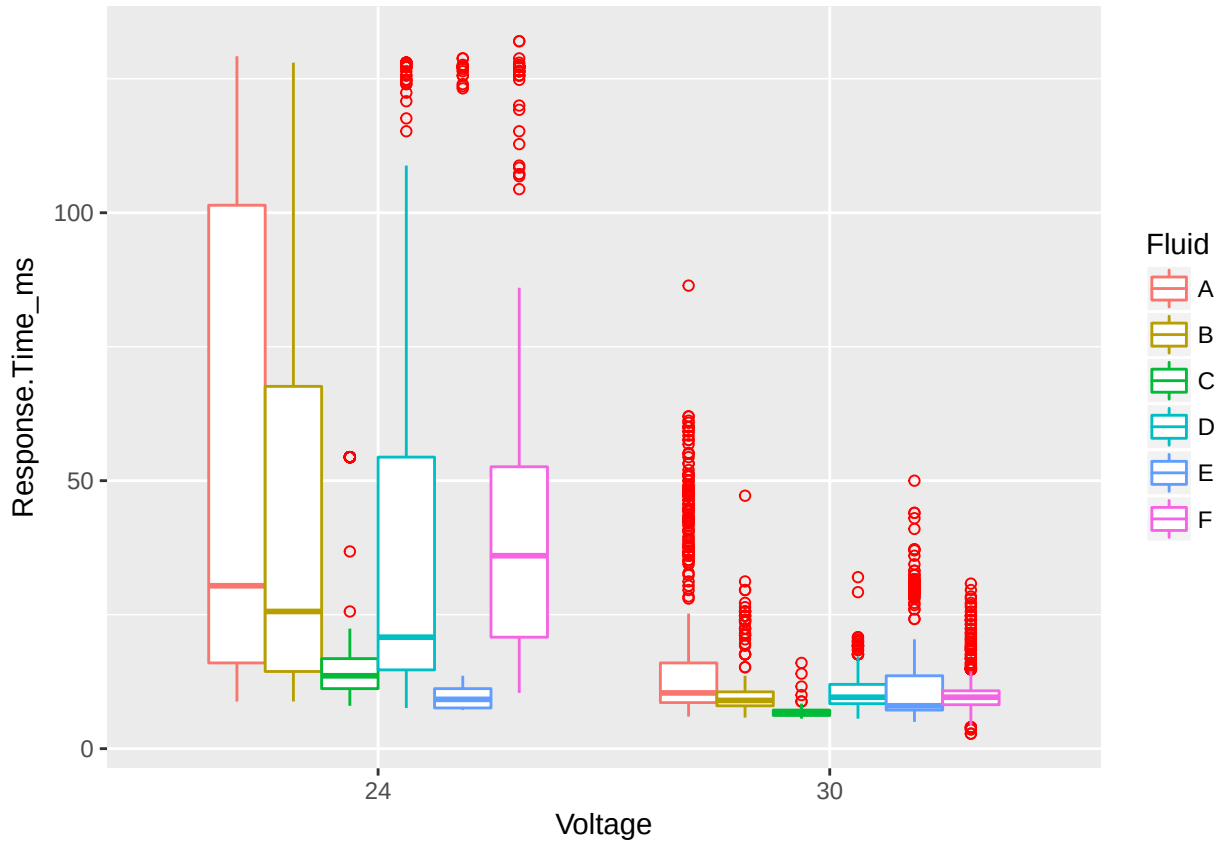
```
##  Valve.Rev  Fluid    Time.Between.Actuations_hr Plunger.Age Coil.Age
##  New:2082   A: 845   Min.   :  0.0              New:2692    New:2722
##  Old:3118   B: 400   1st Qu.:  0.0              Old:2508    Old:2478
##             C: 378   Median : 24.0
##             D: 479   Mean   : 32.5
##             E:1059   3rd Qu.: 24.0
##             F:2039   Max.   :336.0
##  Voltage   Seal.Type Seal.Age   Response.Time_ms
##  24:1099   A:5080    New:2922   Min.   :  2.80
##  30:4101   B: 120    Old:2278   1st Qu.:  8.00
##                                 Median : 10.00
##                                 Mean   : 17.64
##                                 3rd Qu.: 14.40
##                                 Max.   :132.00
```

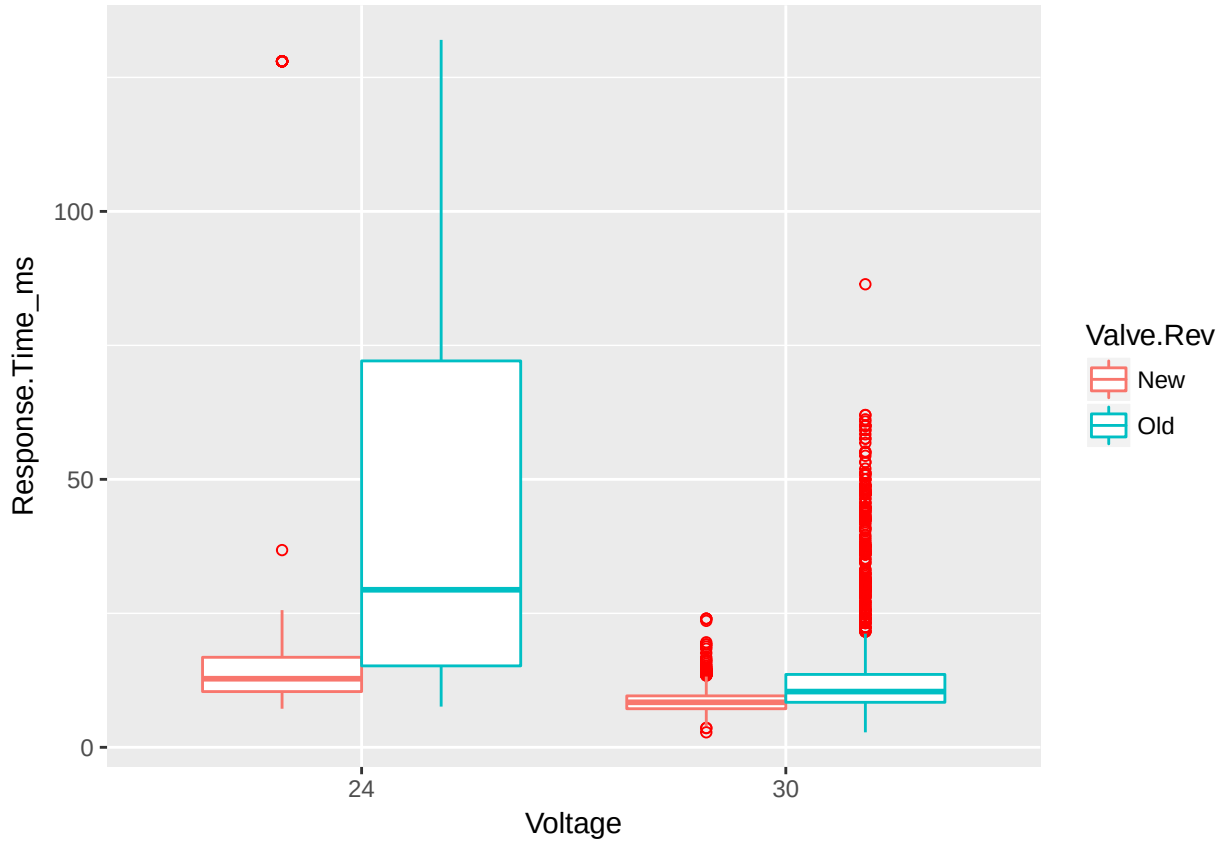
```
## 'data.frame':    5200 obs. of  9 variables:
##  $ Valve.Rev                 : Factor w/ 2 levels "New","Old": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Fluid                     : Factor w/ 6 levels "A","B","C","D",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Time.Between.Actuations_hr: int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Plunger.Age               : Factor w/ 2 levels "New","Old": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Coil.Age                  : Factor w/ 2 levels "New","Old": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Voltage                   : Factor w/ 2 levels "24","30": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Seal.Type                 : Factor w/ 2 levels "A","B": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Seal.Age                  : Factor w/ 2 levels "New","Old": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Response.Time_ms          : num  36 44.2 47.4 42.6 55 47.6 43.2 55 48.4 48 ...
```

where *Valve.Rev* indicates the revision of the valve design, *Fluid* indicates the different fluids as masked factors, *Time.Between.Actuations_hr* indicates the time between valve actuations in hours, **.Age* indicates the age of the indicated component, *voltage* is the applied DC solenoid coil voltage, *Seal.Type* indicates the types of seal materials as masked factors, and *Response.Time_ms* is the time to open the valve in ms.

Plots

The following plots show how the predictors affect the response time


Response.Time_ms
100
50
0
24
30
Voltage
Fluid
A
B
C
D
E
F


Response.Time_ms
100
50
0
24
30
Voltage
Valve.Rev
New
Old