

Course Capstone Project

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October 9, 2017

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

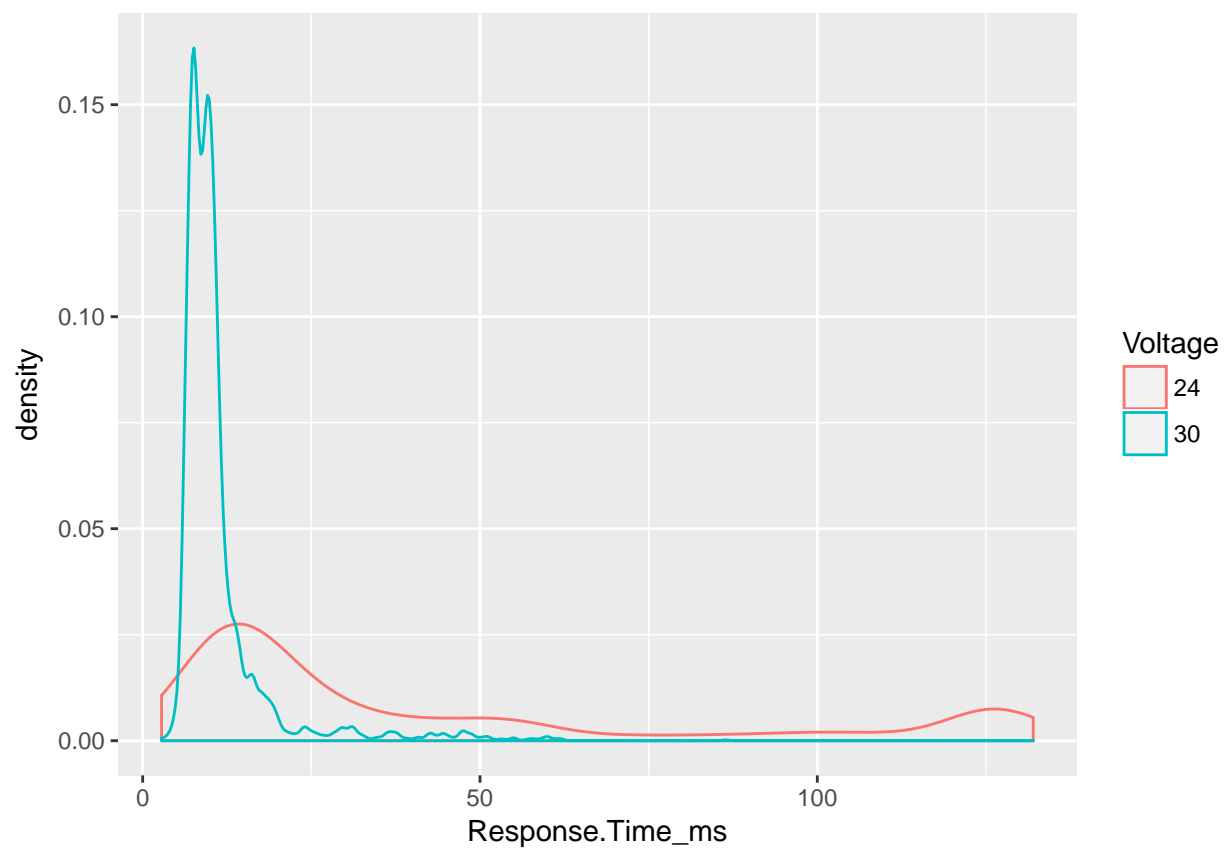
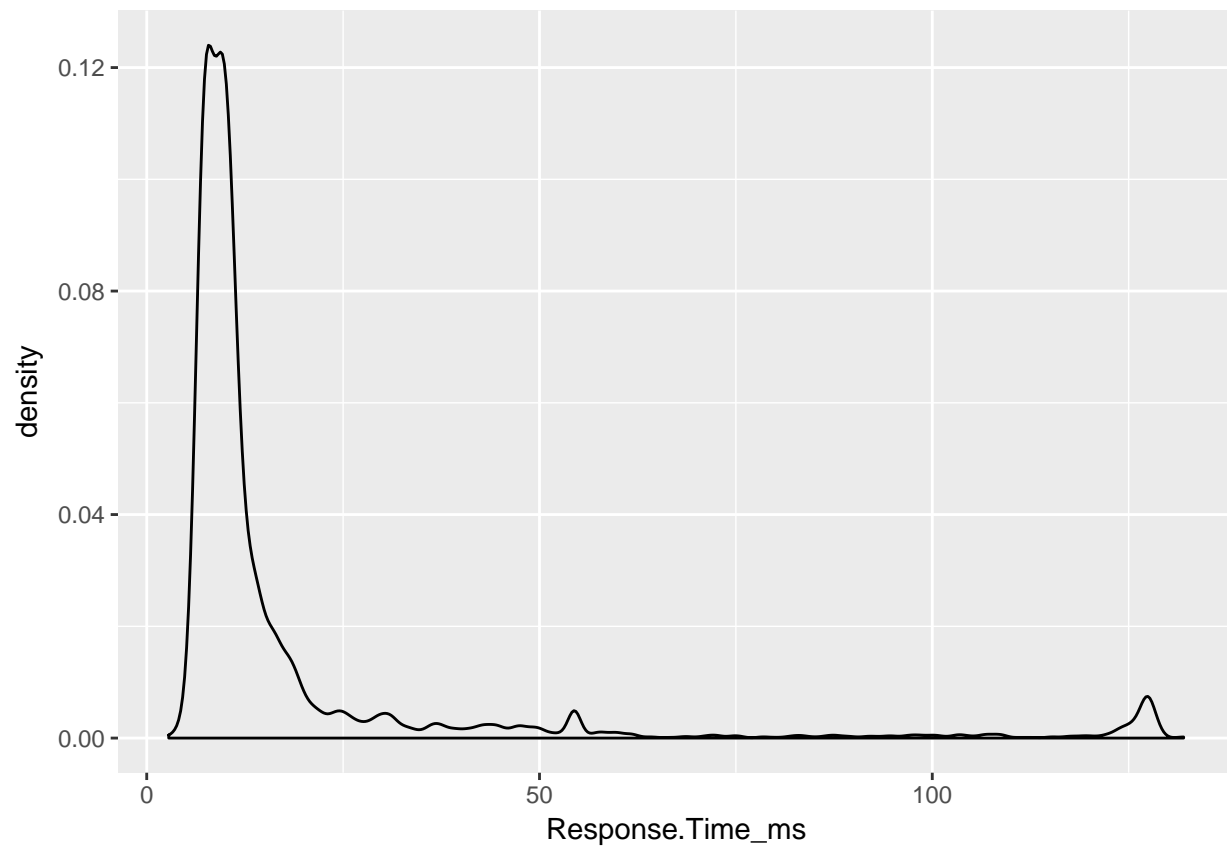
```
## Valve.Rev Fluid Time.Between.Actuations_hr Plunger.Age Coil.Age
## New:2082 A: 845 Min. : 0.0 New:2692 New:2722
## Old:3118 B: 400 1st Qu.: 0.0 Old:2508 Old:2478
## C: 378 Median : 24.0
## D: 479 Mean : 32.5
## E:1059 3rd Qu.: 24.0
## F:2039 Max. :336.0
## Voltage Seal.Type Seal.Age Response.Time_ms
## 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

In the interest of report length, we show the following two density plots that illustrate the distribution of response time, overall and grouped by voltage, respectively. Additionally, box plots of response time versus the other variables would show how response time varies due to the other variables in the data set.



Modeling

Here we will fit a Bayesian linear regression model with interactions.