# Project 2

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## Background

A chemist is studying the chemical make-up of three tablets from three distinct brands of aspirin using liquid chromatography-tandem mass spectrometry. Each tablet was tested in triplicate, which means we took three measurements of the identical pill for one peak. We have information for seven peaks in our dataset.

## Objective

Our main objective is to see whether there is a difference in each peak between the three kinds of tablets.

## Data

Our data consists of three aspirin tablets from three distinct manufacturers, each with three different aliqout strengths. It also includes the blank and retention times for which the intensity was calculated.
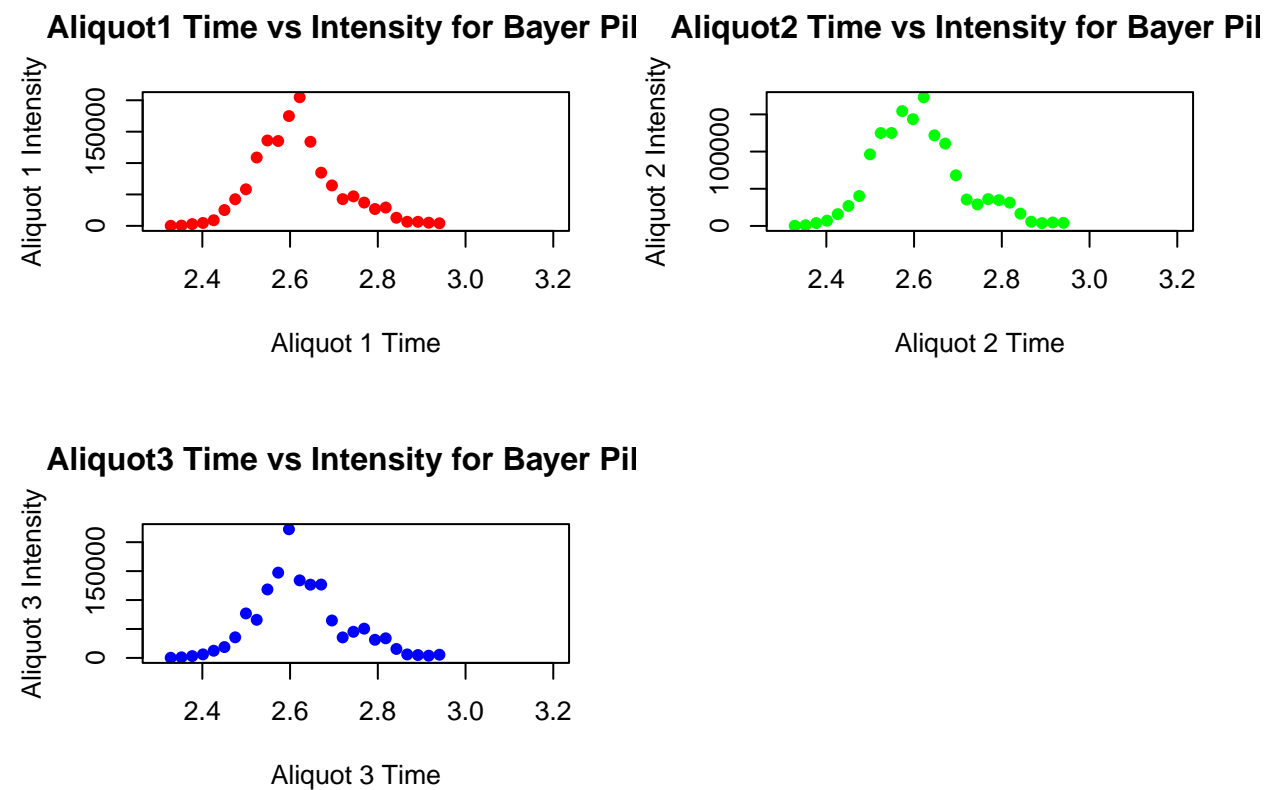
## Algorithm

We began by conducting exploratory data analysis for each pill of each brand beneath each peak. We used the Intensity versus Time Plot, QQPlot, Boxplots, and SmoothScattered plots for exploratory data analysis. We can see the distribution of numerical data and skewness by displaying the data quartiles (or percentiles) and averages using the Intensity vs Time Plot; QQplots shows the type of distribution; and Boxplots shows the distribution of numerical data and skewness by displaying the data quartiles (or percentiles) and averages.

After that, we used Smoothscatterd plot to create a smoothed color density representation of a scatterplot using a (2D) kernel density estimate.
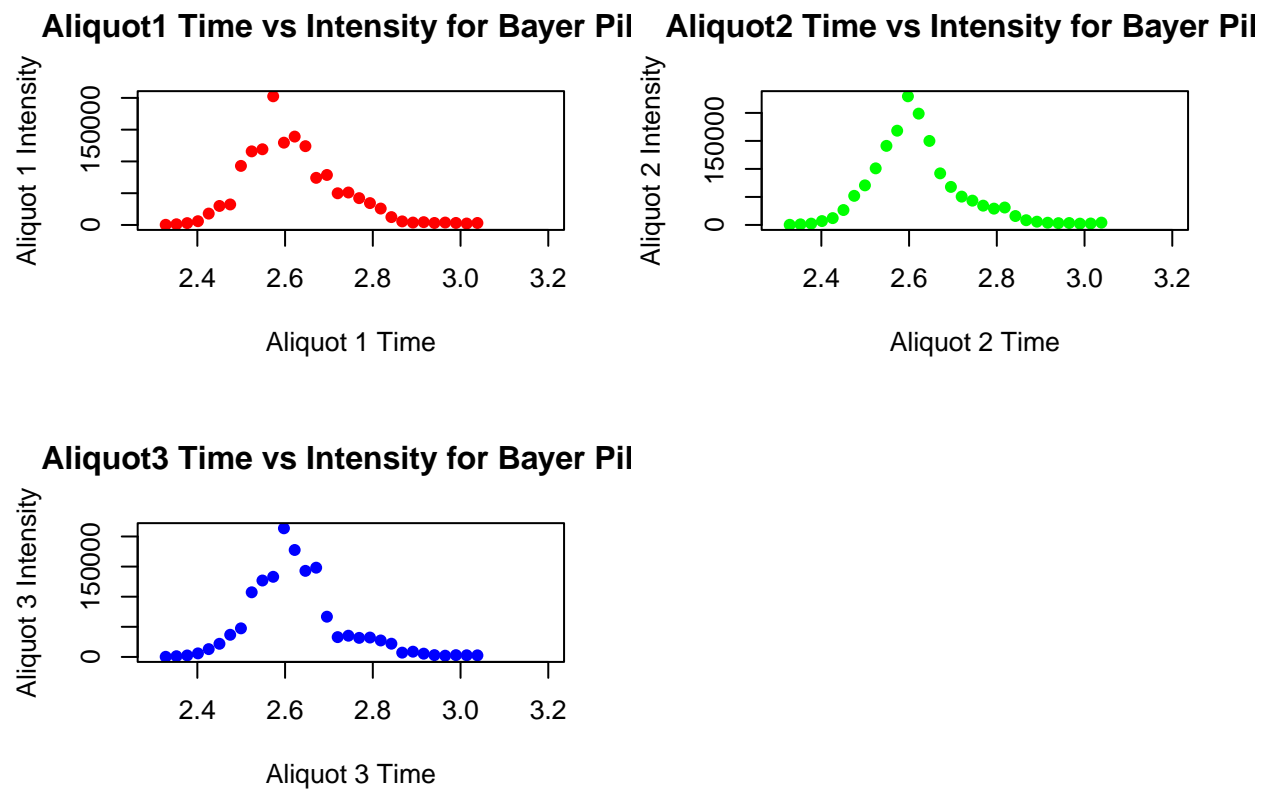
We then used the mean of the intensity values for a specific aliqout for each tablet of each brand to compute the area under a peak (AUP). Then we averaged the means of three aliqout intensities for each pill type, yielding nine total averages of intensities for three pills from each brand. Then, for each peak, we ran a one-way anova. ANOVA shows us whether there are differences in group means, but it doesn't tell us what they are. Later, we used a Tukey's Honestly Significant Difference (Tukey's HSD) post-hoc test for pairwise comparisons to see whether groups were statistically different from one another.

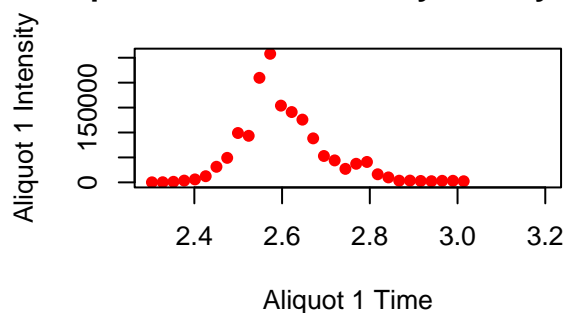# Loading Data Set

Bayer Pill 1 from Peak 136.5 92.90

### Aliquot1 Time vs Intensity for Bayer Pil



### Aliquot2 Time vs Intensity for Bayer Pil



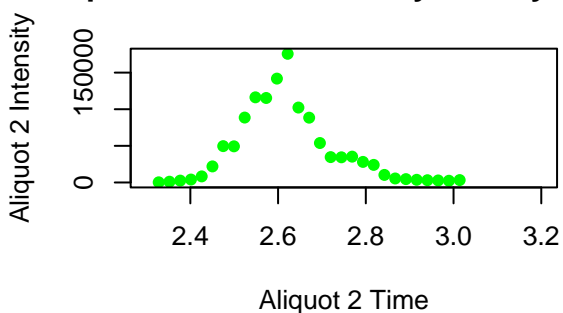### Aliquot3 Time vs Intensity for Bayer Pil
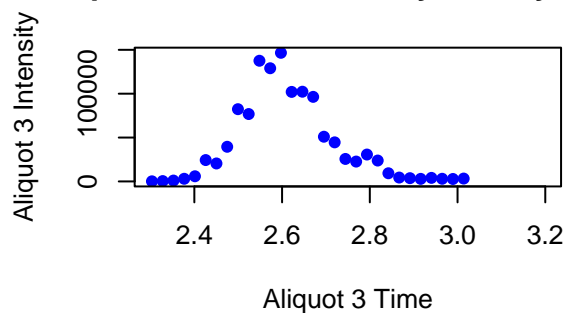
Bayer Pill 2 from Peak 136.5 92.90

## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



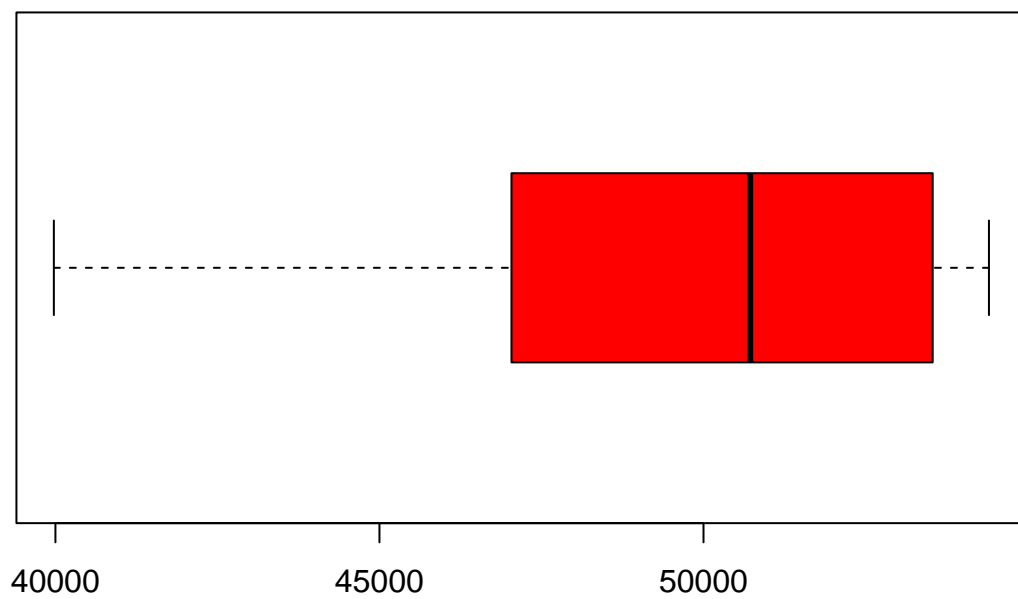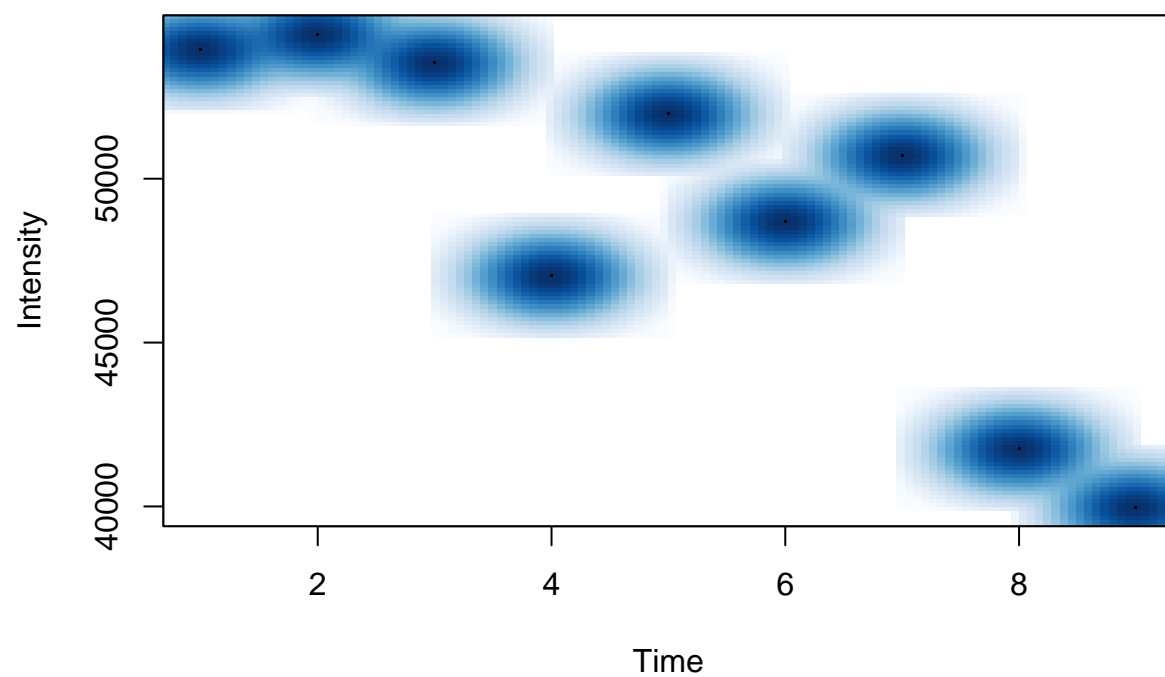## Aliquot3 Time vs Intensity for Bayer Pil



### Bayer Pill 3 from Peak 136.5 92.90

## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



## Aliquot3 Time vs Intensity for Bayer Pil



Average Bayer Pill Intensities

Data Visualization for Bayer Pill Peak 136.5 92.90

```
##       BP.136
##  Min.   :39976
##  1st Qu.:47037
##  Median :50720
##  Mean   :49116
##  3rd Qu.:53536
##  Max.   :54405
```

# Boxplot of Bayer Pills: Peak 136.5 92.90

Scatterplot for Bayer Pills from Peak 136.5 92.90

**Aliquot1 Time vs Intensity for PV Pill1**



**Aliquot2 Time vs Intensity for PV Pill1**
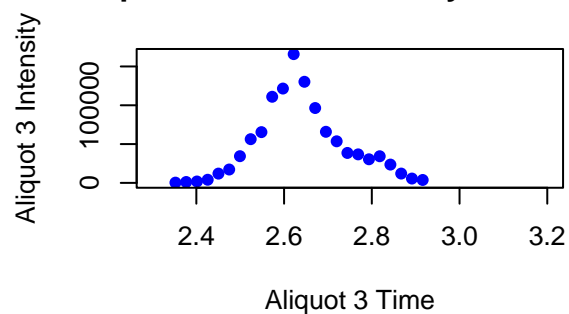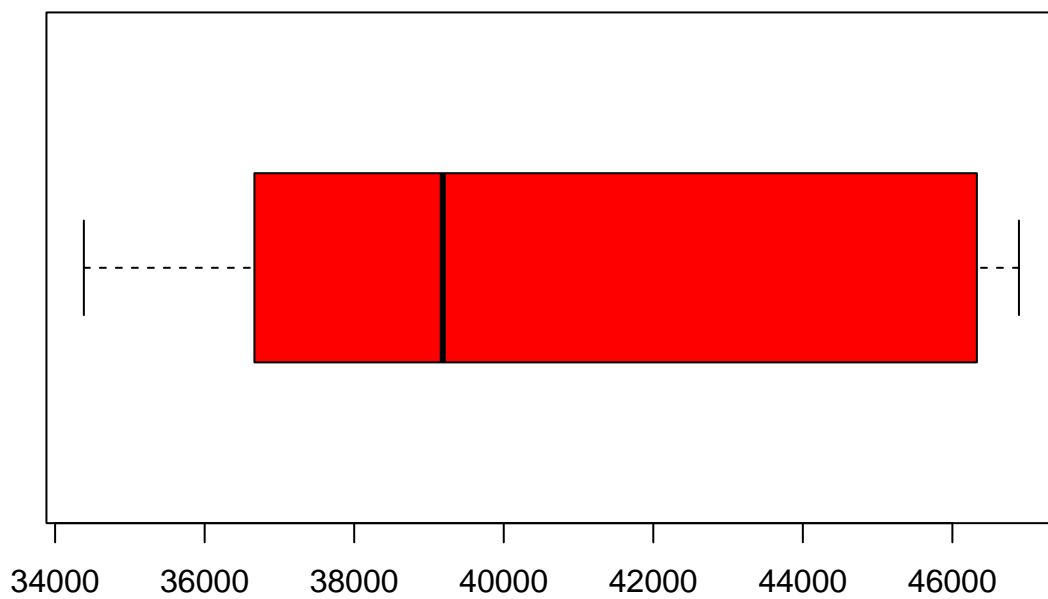


**Aliquot3 Time vs Intensity for PV Pill1**

### Aliquot1 Time vs Intensity for PVPill2



### Aliquot2 Time vs Intensity for PVPill2
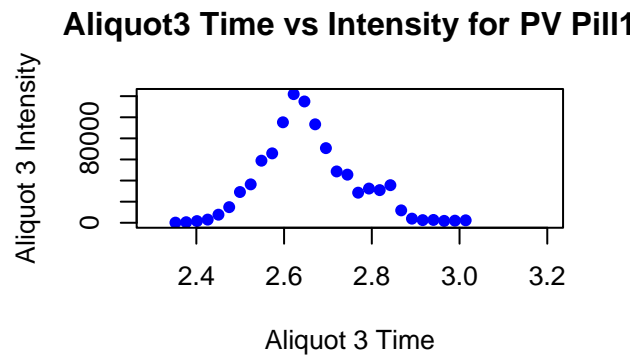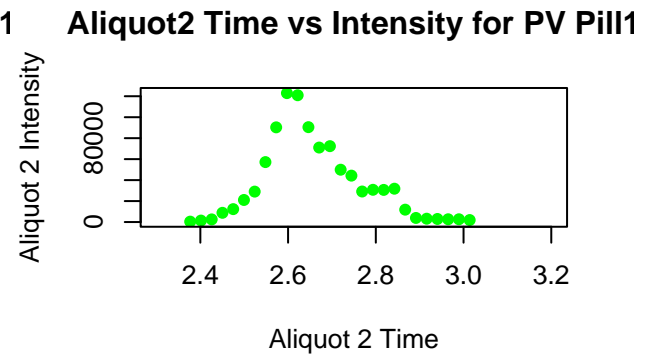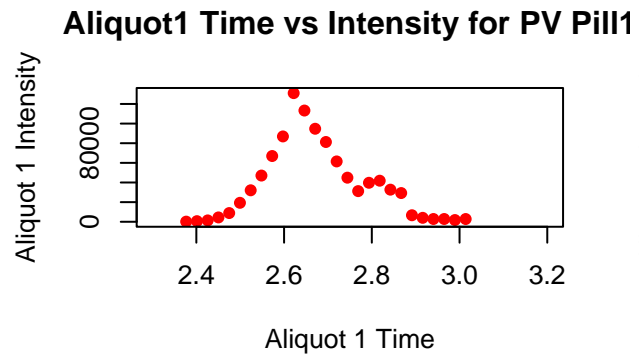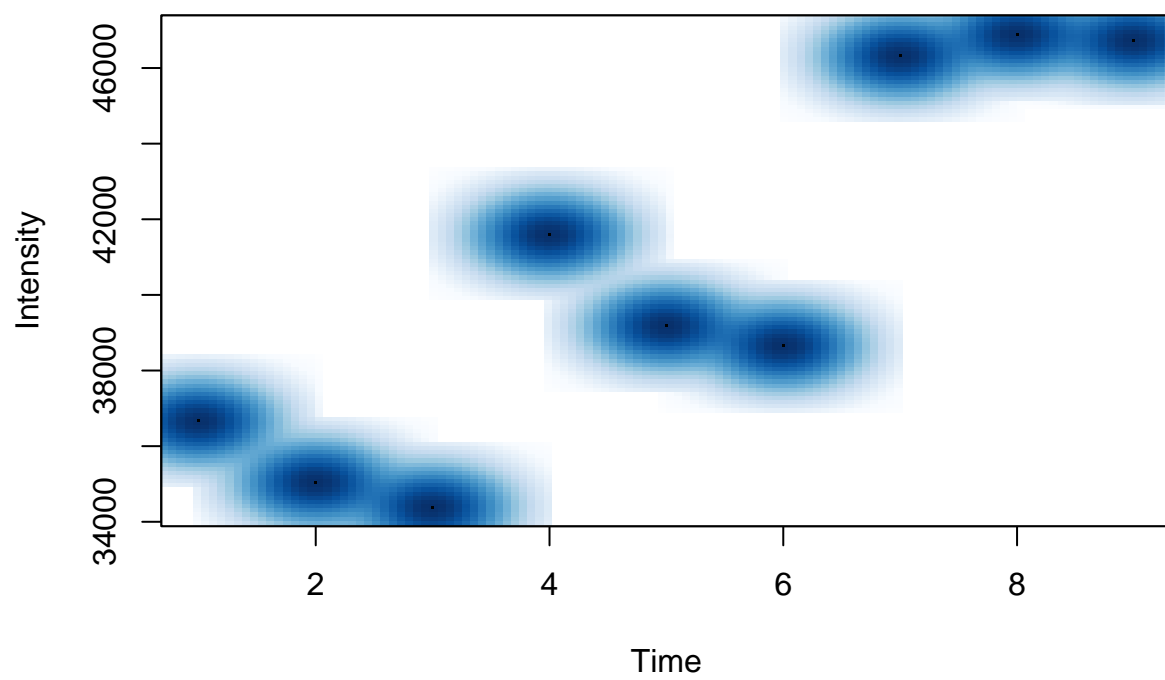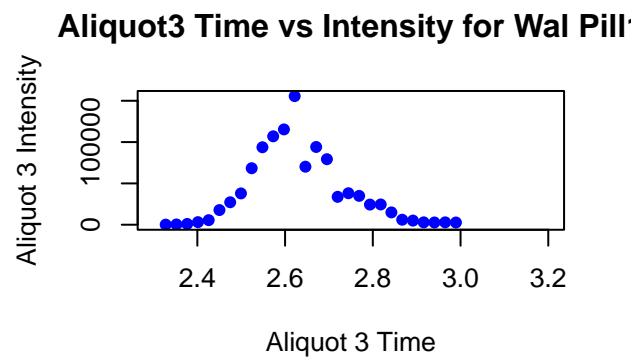


### Aliquot3 Time vs Intensity for PVPill2
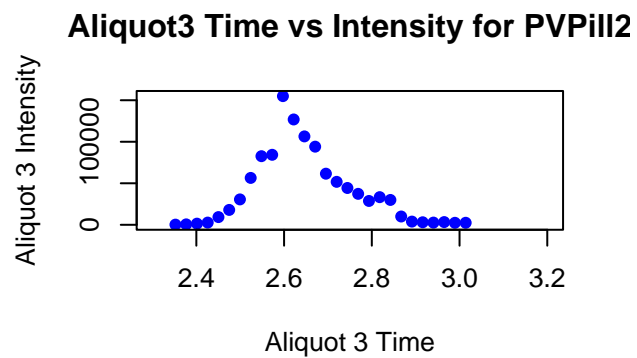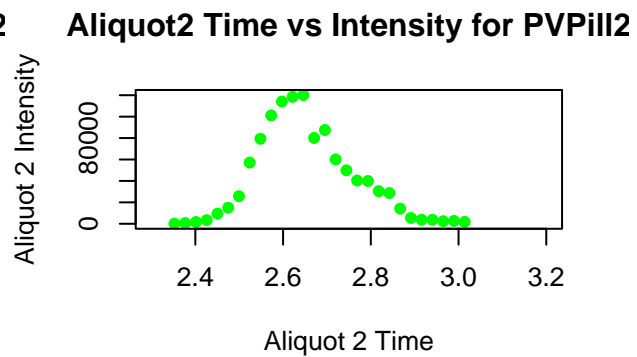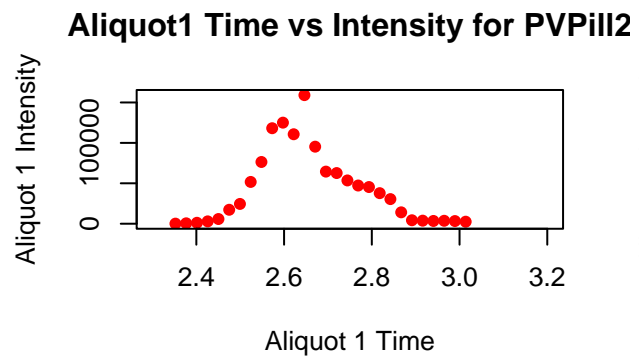
PV 3 Pill from Peak 136.5 92.90
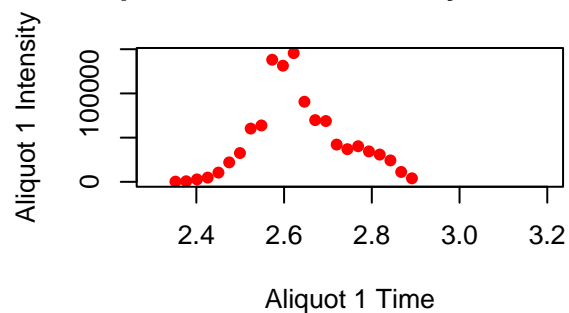
**Aliquot1 Time vs Intensity for PVPill3**



**Aliquot2 Time vs Intensity for PVPill3**
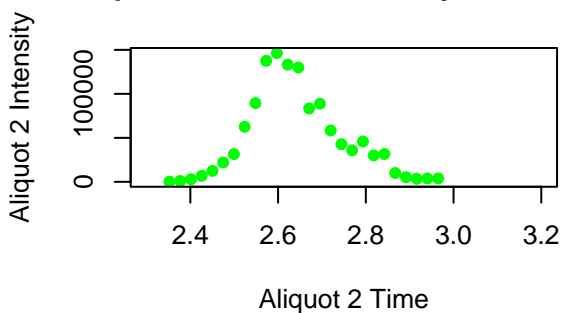


**Aliquot3 Time vs Intensity for PVPill3**



Average P.V Pill Intensities

Data Visualization for PV Pill Peak 136.5 92.90

```
##        PV.136
##  Min.   :34384
##  1st Qu.:36666
##  Median :39185
##  Mean   :40612
##  3rd Qu.:46327
##  Max.   :46890
```
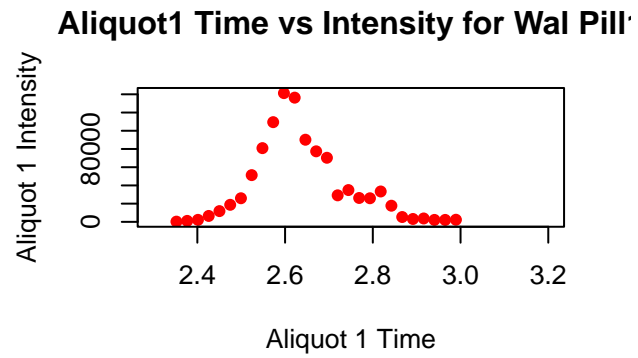
**Boxplot of PV Pills: Peak 136.5 92.90**
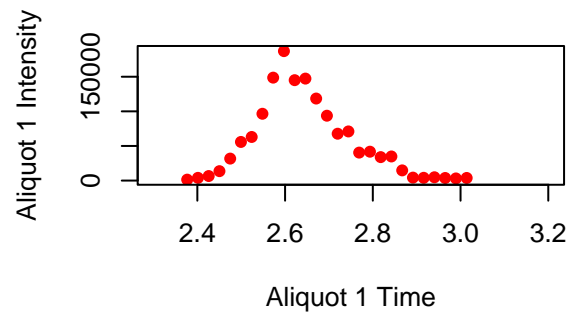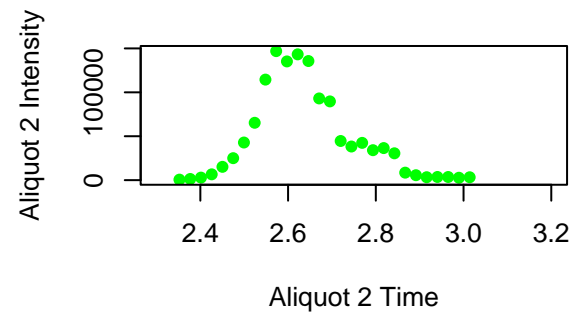
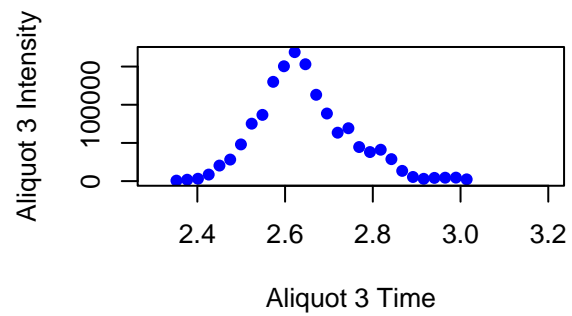Scatterplot for PV Pills from Peak 136.5 92.90

## Aliquot1 Time vs Intensity for Wal Pill



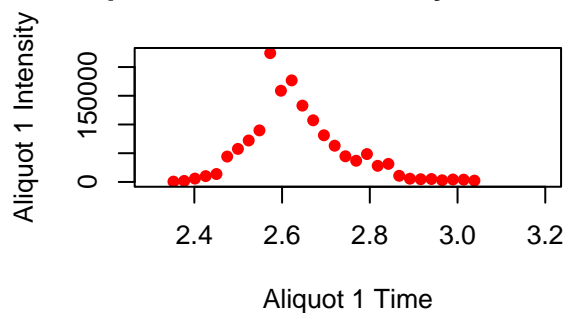## Aliquot2 Time vs Intensity for Wal Pill
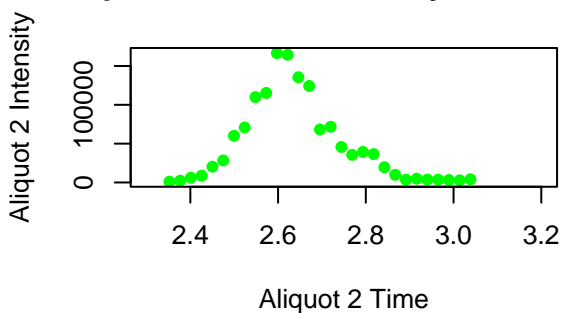


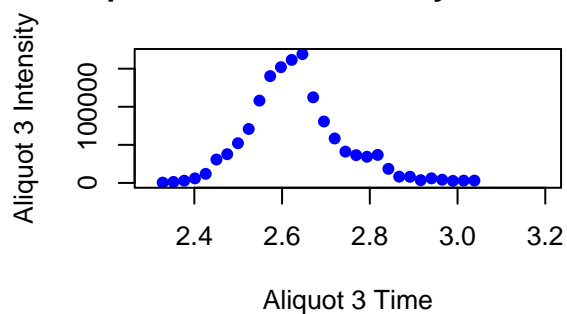## Aliquot3 Time vs Intensity for Wal Pill
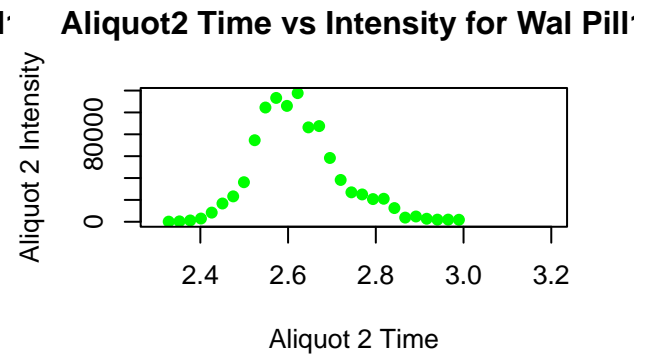
Wal Pill 2 from Peak 136.5 92.90

**Aliquot1 Time vs Intensity for Wal Pill2**



**Aliquot2 Time vs Intensity for Wal Pill2**



**Aliquot3 Time vs Intensity for Wal Pill2**

**Wal Pill 3 from Peak 136.5 92.90**

### Aliquot1 Time vs Intensity for Wal Pill3



### Aliquot2 Time vs Intensity for Wal Pill3



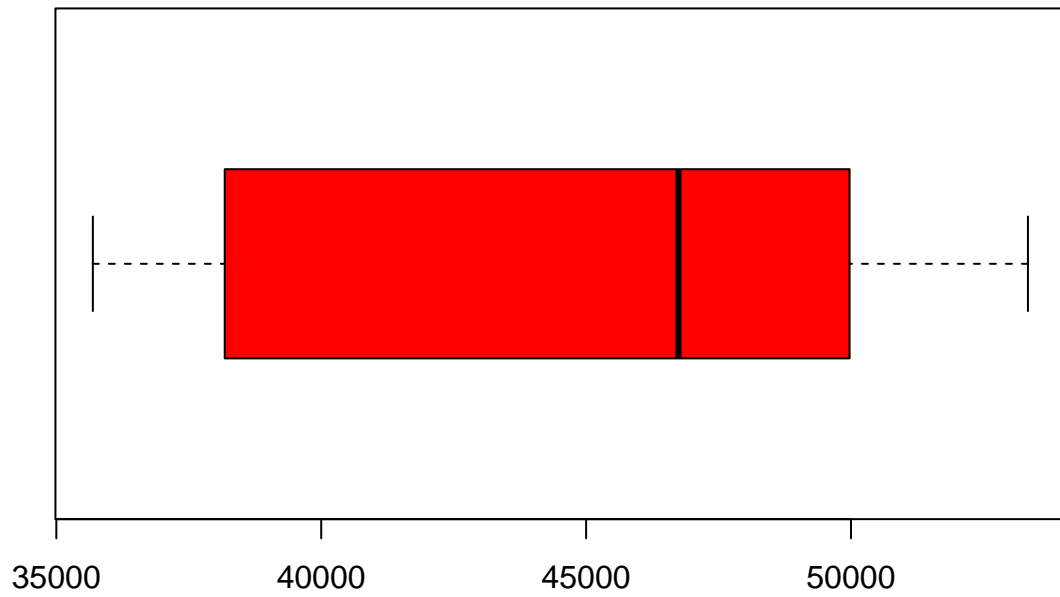### Aliquot3 Time vs Intensity for Wal Pill3



## Average Wal Pill Intensities
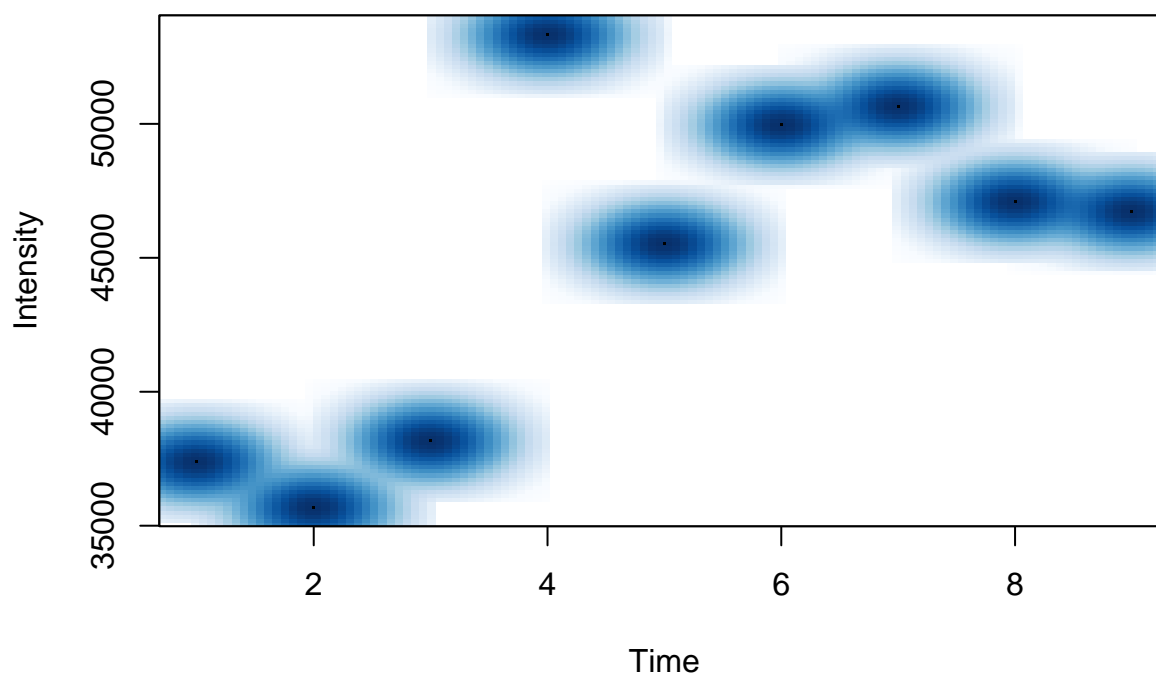
## Data Visualization for Wal Pill Peak 136.5 92.90

```
##       WP.136
##  Min.   :35689
##  1st Qu.:38178
##  Median :46745
##  Mean   :44958
##  3rd Qu.:49974
##  Max.   :53341
```
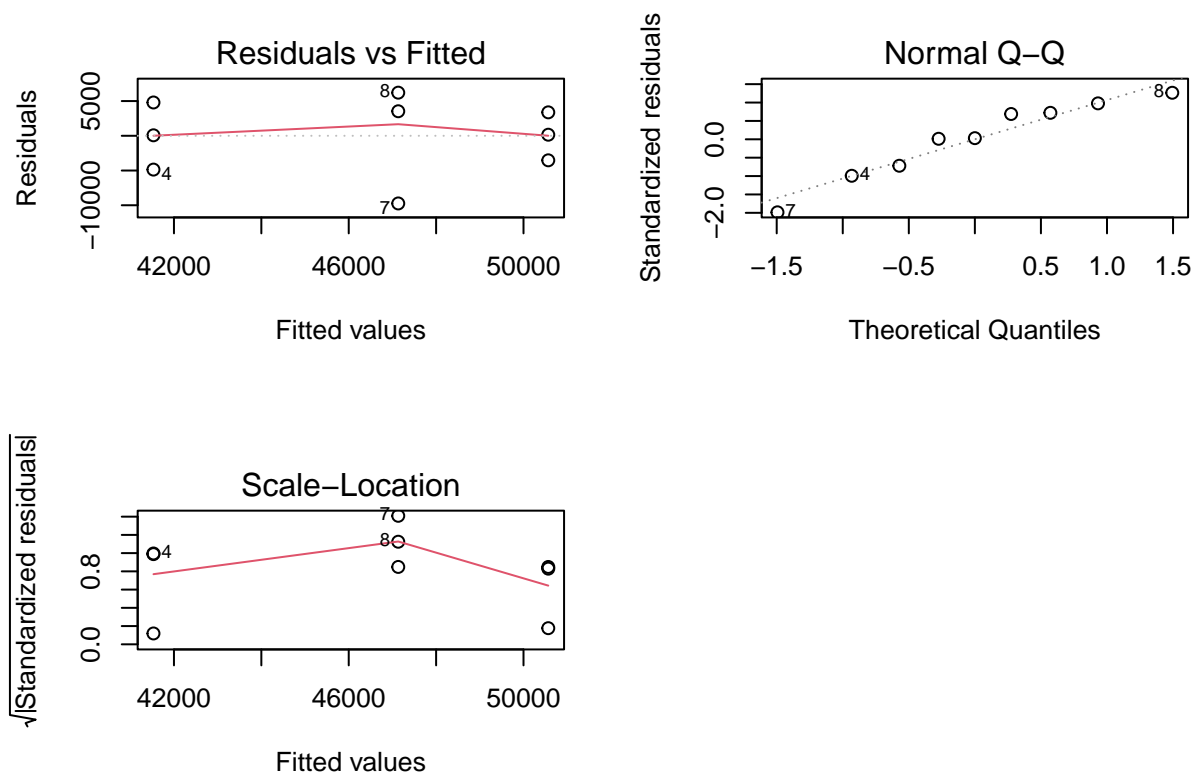
**Boxplot of WP Pills: Peak 136.5 92.90**

**Scatterplot for WP Pills from Peak 136.5 92.90**



```
## Anova of Peak 136.5 92.90

##              Df    Sum Sq  Mean Sq F value Pr(>F)
## Pills         2 124814664 62407332    1.73  0.255
## Residuals     6 216416836 36069473


## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```
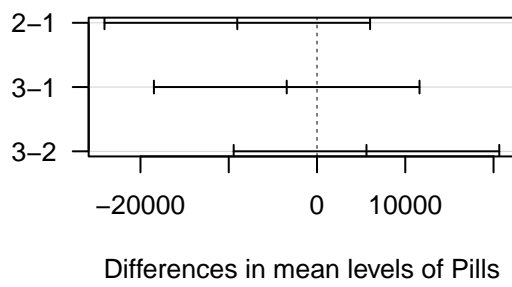
## Residuals vs Fitted



## Normal Q–Q



## Scale–Location



```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Intensity ~ Pills, data = da.136)
##
## $Pills
##          diff        lwr       upr      p adj
## 2-1 -9035.583 -24081.493  6010.327 0.2350224
## 3-1 -3433.351 -18479.261 11612.559 0.7722323
## 3-2  5602.232  -9443.678 20648.142 0.5255463
```

## 95% family–wise confidence level



Differences in mean levels of Pills

The p-value of the pills variable is low (p > 0.05), For this peak location, it appears that there are no substantial differences between the tablets. According to the findings of the post-hoc test, there are no statistically significant differences (p > 0.05) between pill groups.
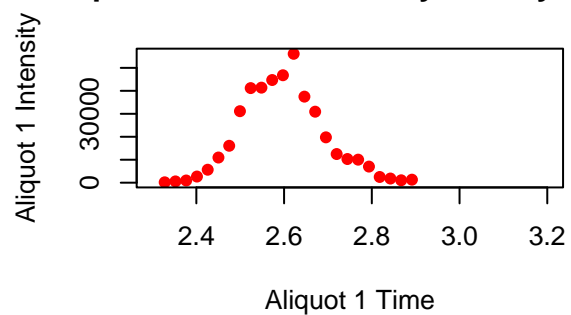
# Loading Data for Peak 178.7 93.00
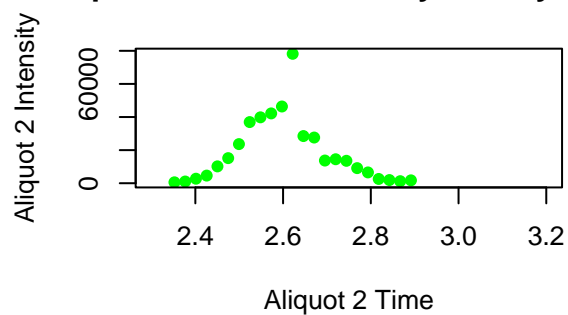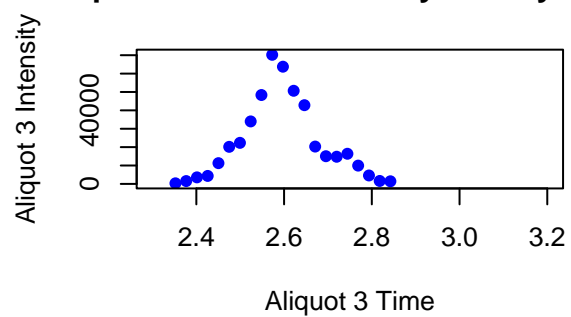
Bayer Pill 1 from Peak 178.7 93.00
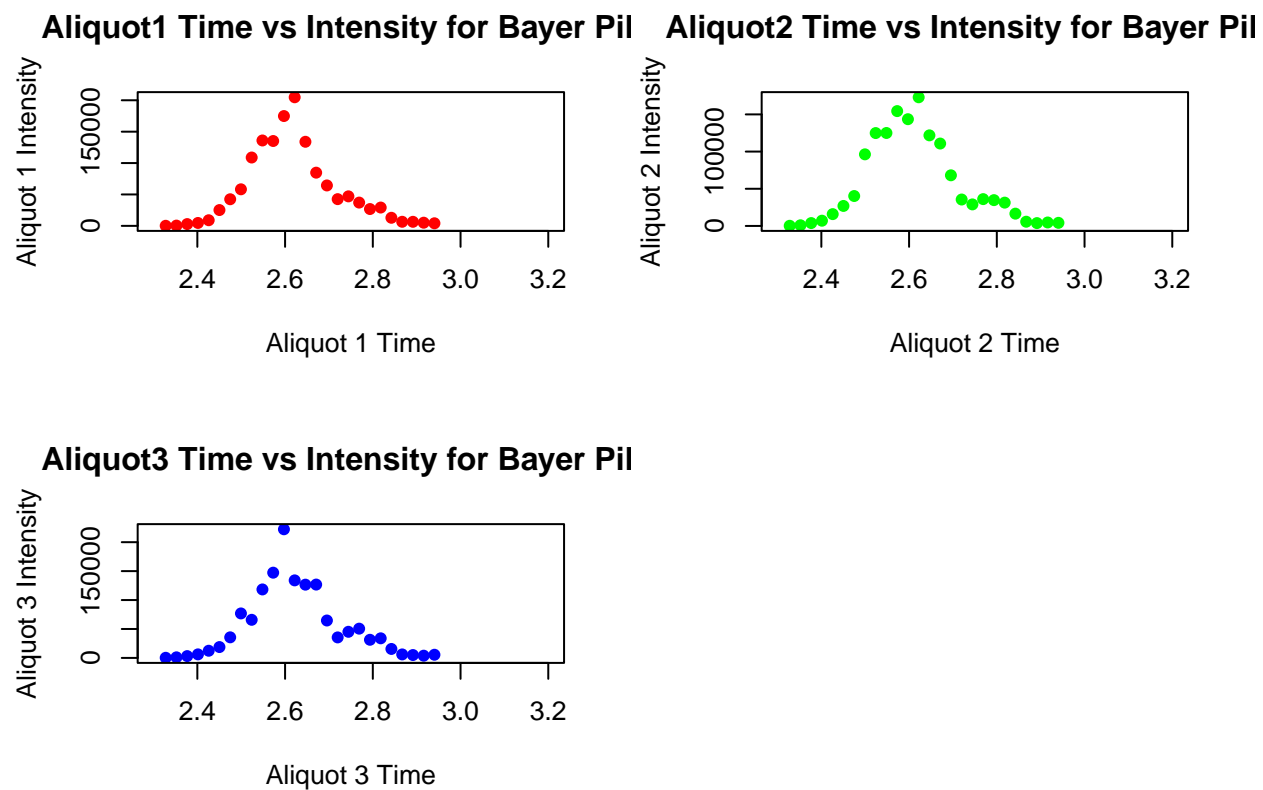
## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



## Aliquot3 Time vs Intensity for Bayer Pil



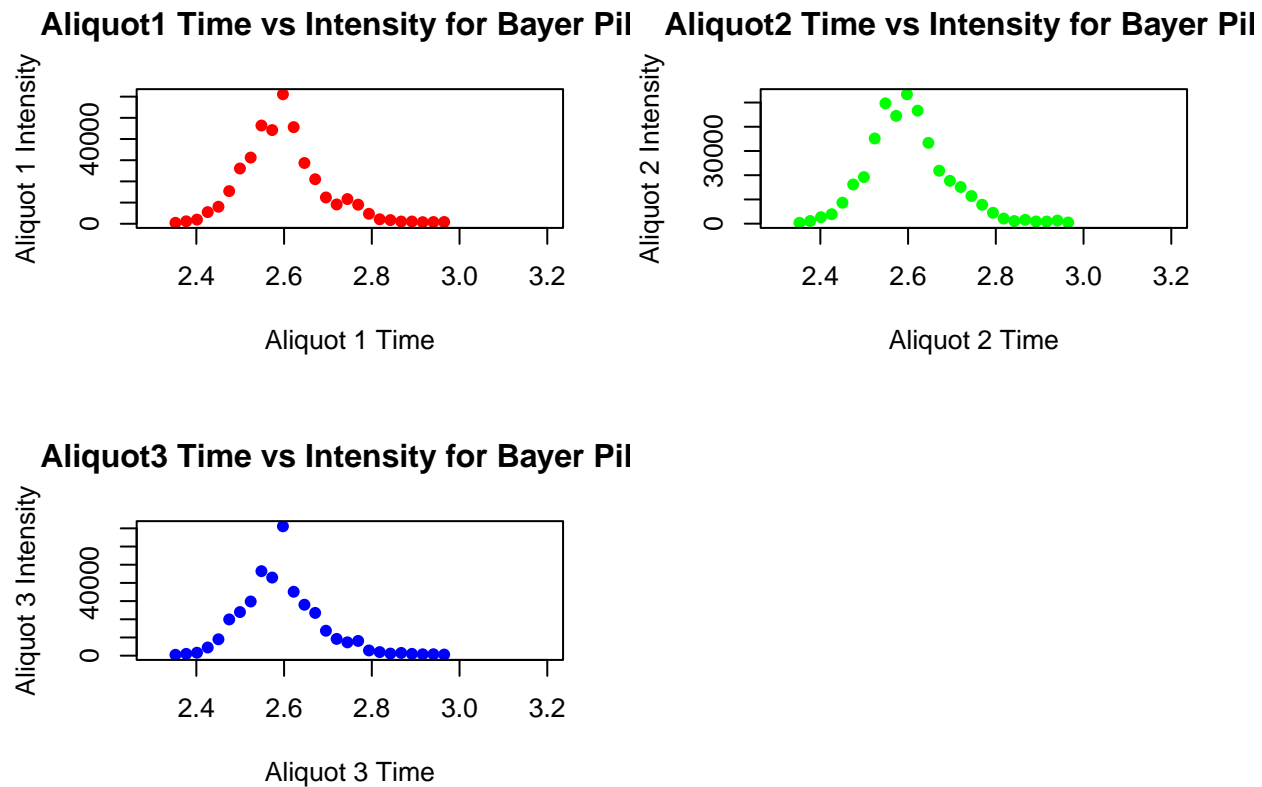### Bayer Pill 2 from Peak 178.7 93.00

## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



## Aliquot3 Time vs Intensity for Bayer Pil
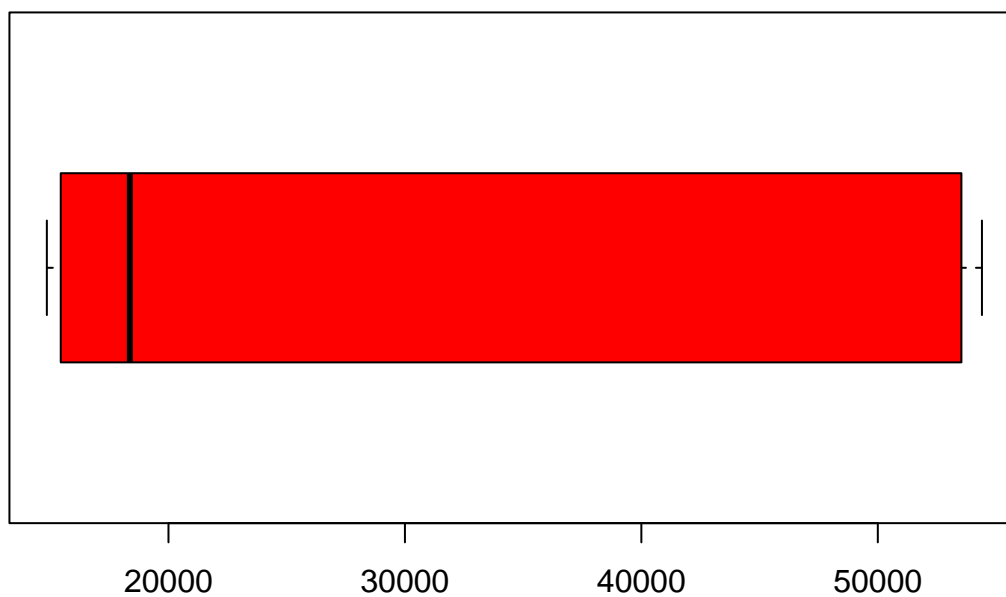
Bayer Pill 3 from Peak 178.7 93.00

### Aliquot1 Time vs Intensity for Bayer Pil



### Aliquot2 Time vs Intensity for Bayer Pil



### Aliquot3 Time vs Intensity for Bayer Pil



Average Bayer Pill Intensities for peak 178.7 93.00

Data Visualization for Bayer Pill for peak 178.7 93.00

```
##       BP.178
##  Min.   :14856
##  1st Qu.:15444
##  Median :18366
##  Mean   :29495
##  3rd Qu.:53536
##  Max.   :54405
```
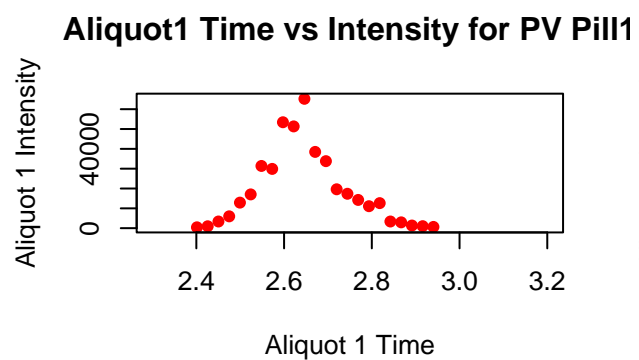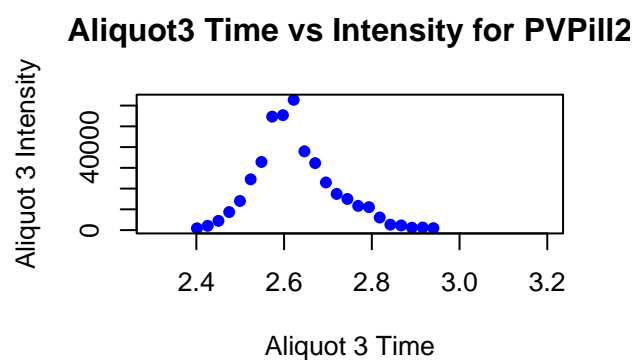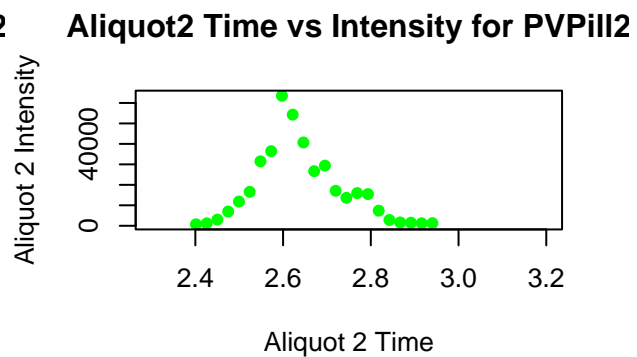
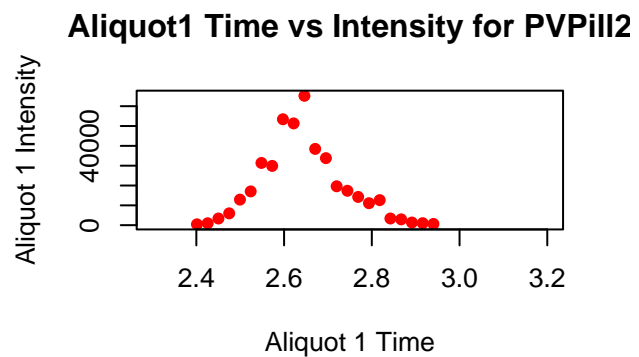**Boxplot of Bayer Pills: Peak 178.7 93.00**
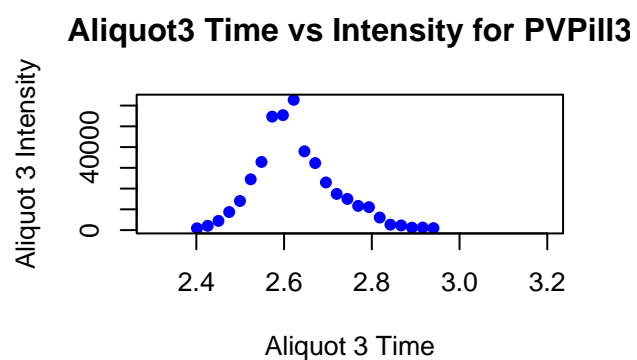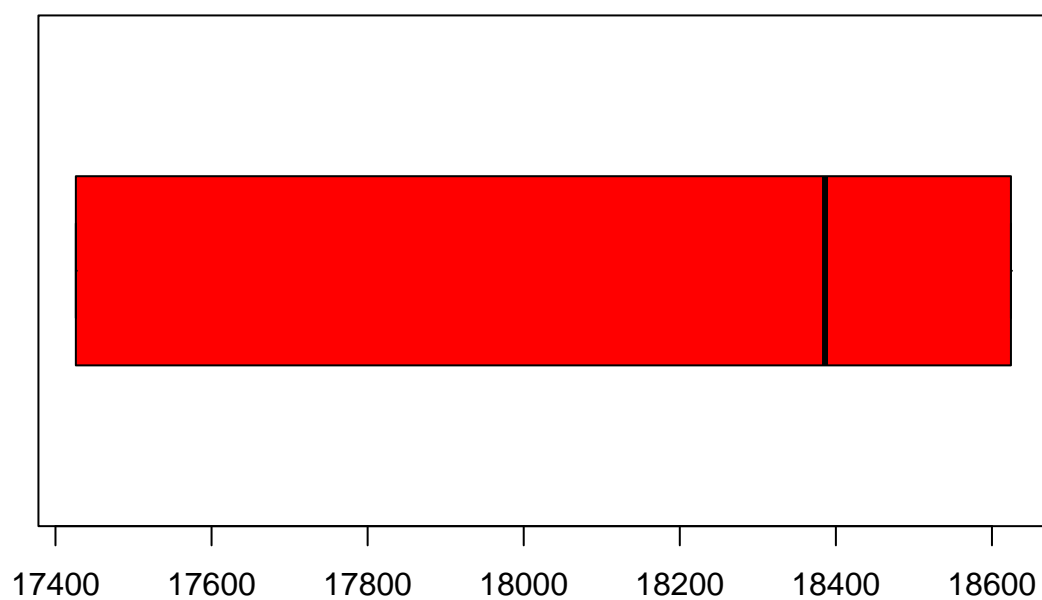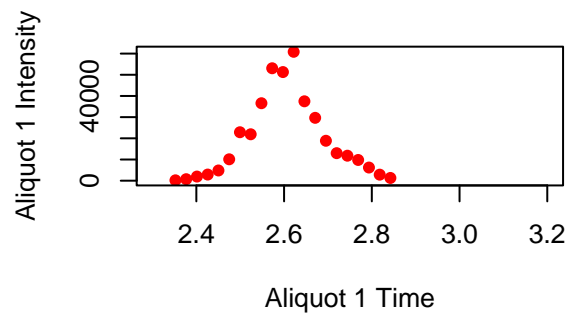
# Scatterplot for Bayer Pills from Peak 178.7 93.00



### PV 1 Pill from Peak 178.7 93.00

**Aliquot1 Time vs Intensity for PV Pill1**

**Aliquot2 Time vs Intensity for PV Pill1**

**Aliquot3 Time vs Intensity for PV Pill1**

### PV 2 Pill from Peak 178.7 93.00

## Aliquot1 Time vs Intensity for PVPill2



## Aliquot2 Time vs Intensity for PVPill2



## Aliquot3 Time vs Intensity for PVPill2



### PV 3 Pill from Peak 178.7 93.00

**Aliquot1 Time vs Intensity for PVPill3**

Aliquot 1 Intensity

40000

0

2.4    2.6    2.8    3.0    3.2

Aliquot 1 Time

**Aliquot2 Time vs Intensity for PVPill3**

Aliquot 2 Intensity

40000

0

2.4    2.6    2.8    3.0    3.2

Aliquot 2 Time

**Aliquot3 Time vs Intensity for PVPill3**

Aliquot 3 Intensity

40000

0

2.4    2.6    2.8    3.0    3.2

Aliquot 3 Time

## Average P.V Pill Intensities Peak 178.7 93.00

## Data Visualization for PV Pill Peak 178.7 93.00

```
##      PV.178
## Min.   :17426
## 1st Qu.:17426
## Median :18386
## Mean   :18146
## 3rd Qu.:18624
## Max.   :18624
```

**Boxplot of PV Pills: Peak 178.7 93.00**

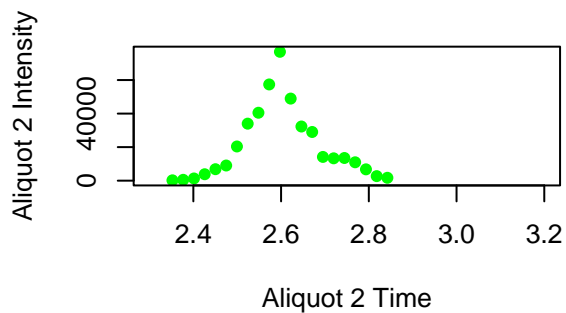**Scatterplot for PV Pills from Peak 178.7 93.00**
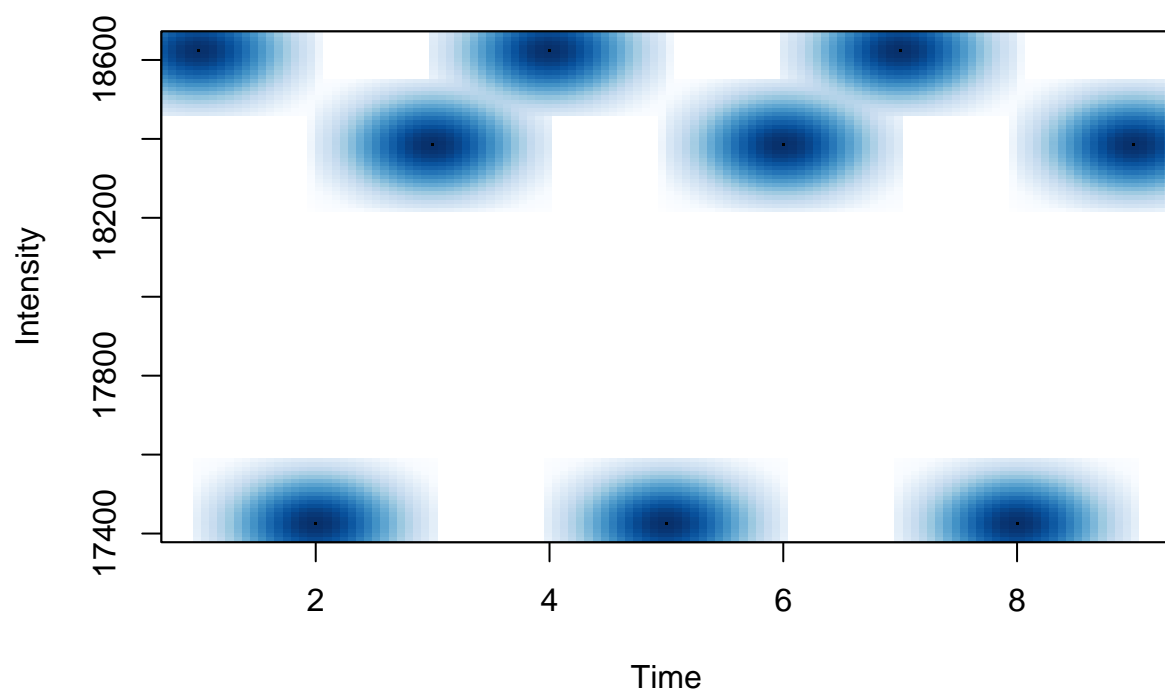


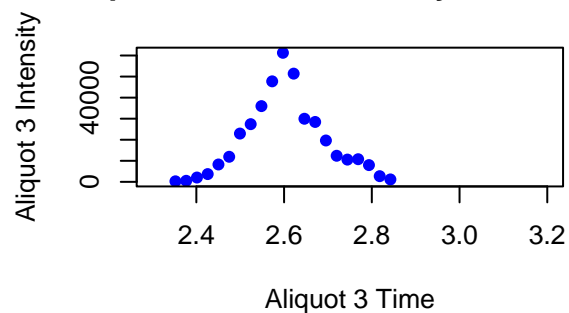### Wal Pill 1 from Peak 178.7 93.00

## Aliquot1 Time vs Intensity for Wal Pill



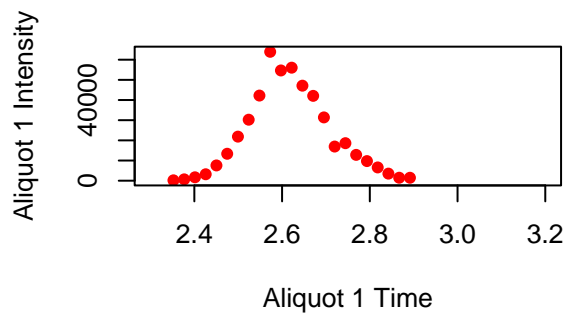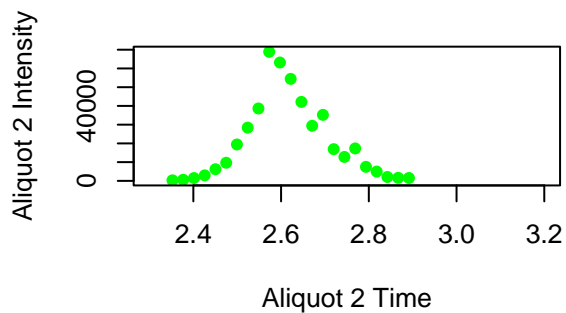## Aliquot2 Time vs Intensity for Wal Pill



## Aliquot3 Time vs Intensity for Wal Pill
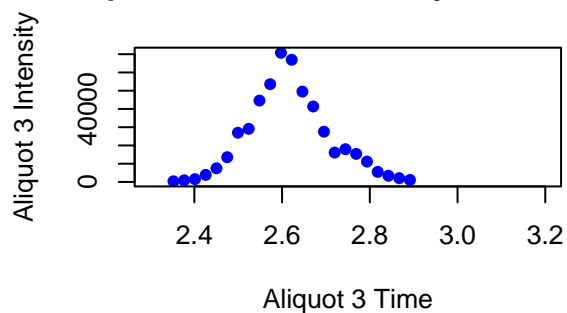


### Wal Pill 2 from Peak 178.7 93.00

## Aliquot1 Time vs Intensity for Wal Pill
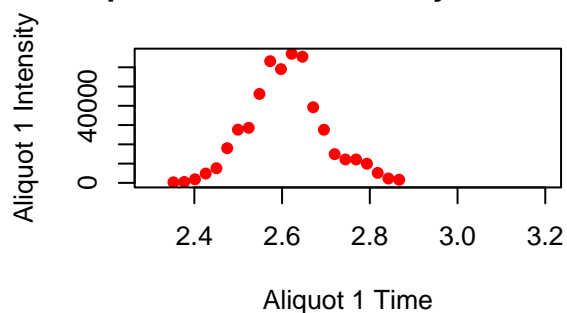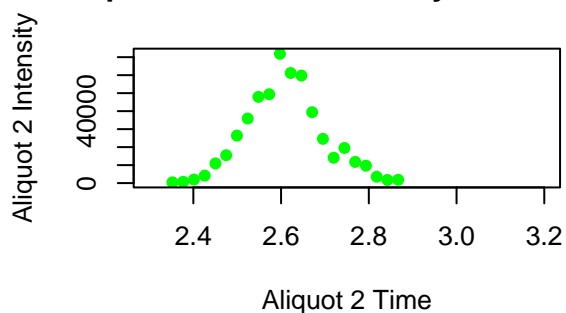
## Aliquot2 Time vs Intensity for Wal Pill

## Aliquot3 Time vs Intensity for Wal Pill
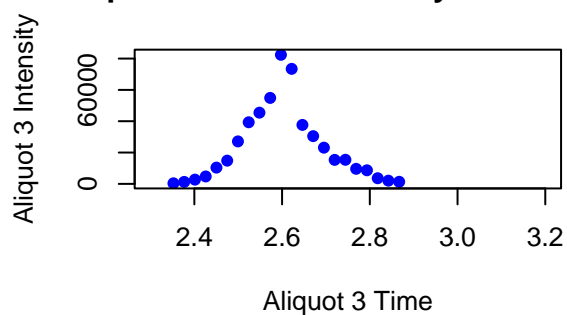
### Wal Pill 3 from Peak 178.7 93.00

**Aliquot1 Time vs Intensity for Wal Pill3**

**Aliquot2 Time vs Intensity for Wal Pill3**

**Aliquot3 Time vs Intensity for Wal Pill3**
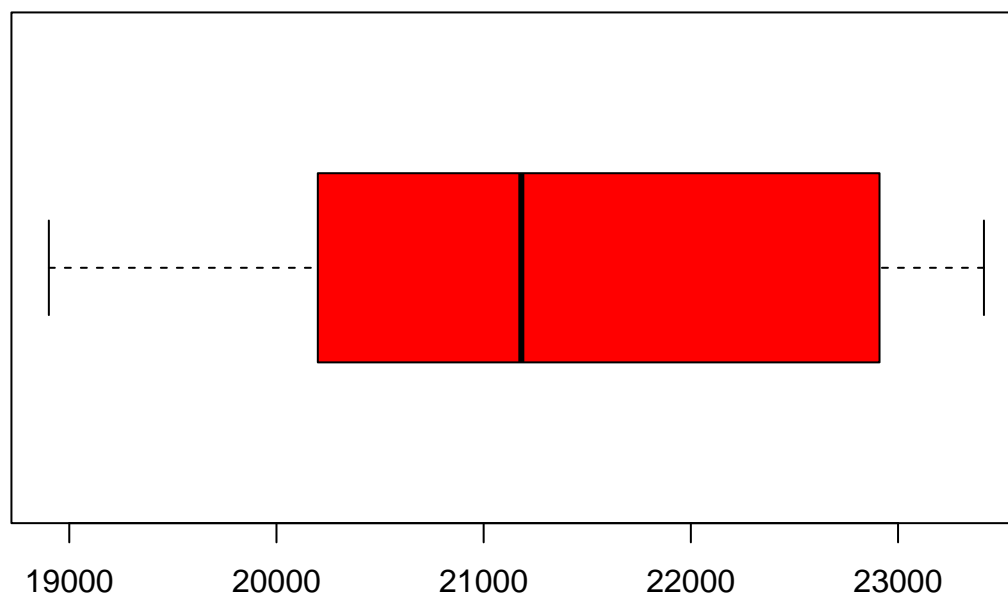
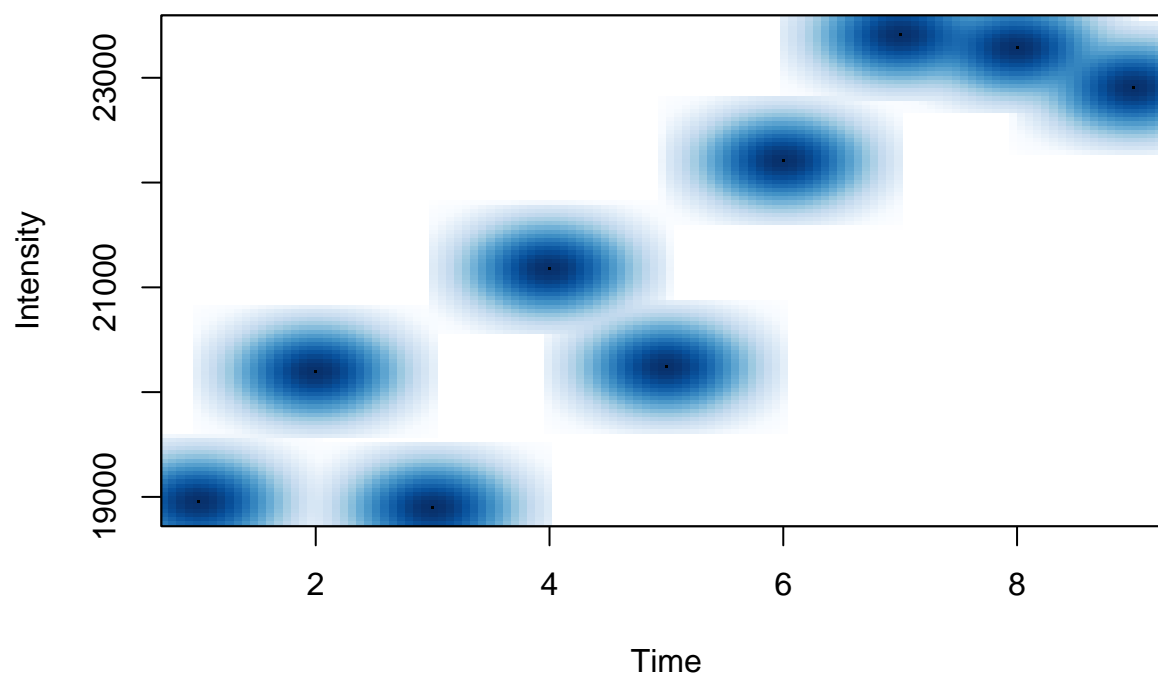## Average Wal Pill Intensities for Peak 178.7 93.00

## Data Visualization for Wal Pill Peak 178.7 93.00

```
##      WP.178
## Min.    :18901
## 1st Qu.:20200
## Median :21182
## Mean    :21257
## 3rd Qu.:22910
## Max.    :23415
```

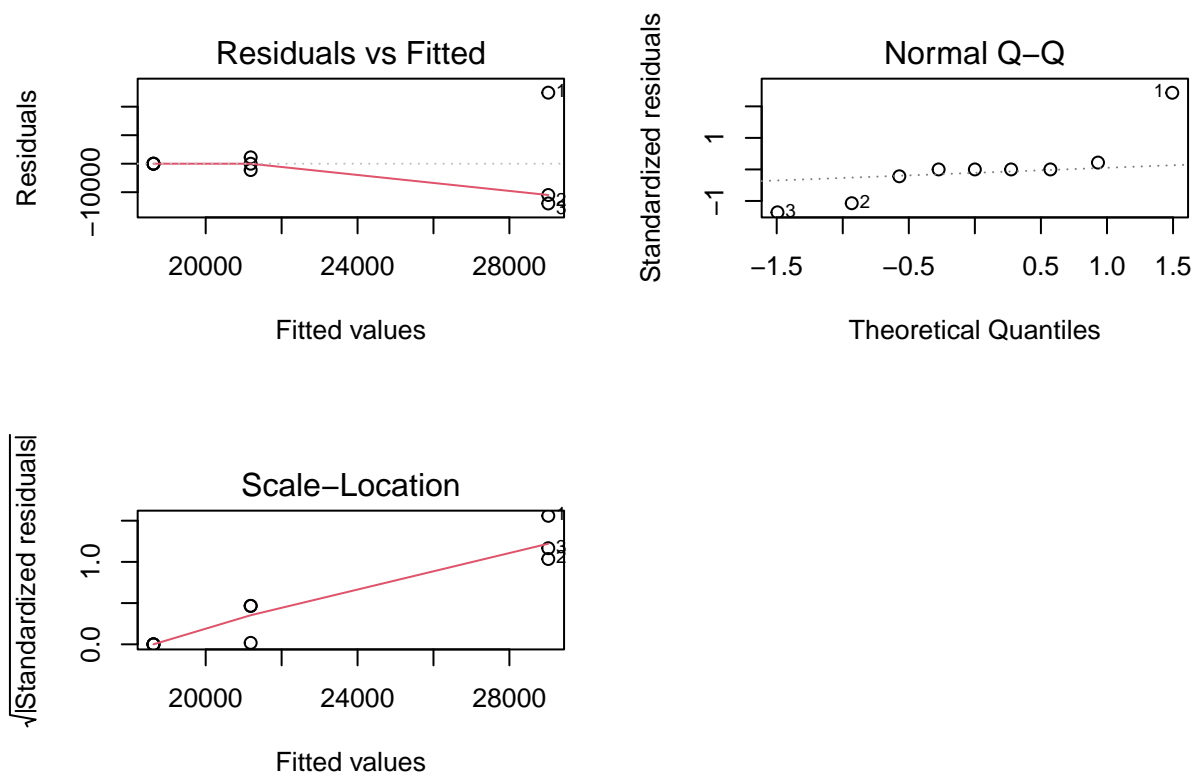## Boxplot of WP Pills: Peak 178.7 93.00

**Scatterplot for WP Pills from Peak 178.7 93.00**



## Anova of Peak 178.7 93.00

```
##              Df    Sum Sq   Mean Sq F value Pr(>F)
## Pills        2 176154638  88077319   0.559  0.599
## Residuals    6 945761144 157626857

## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```
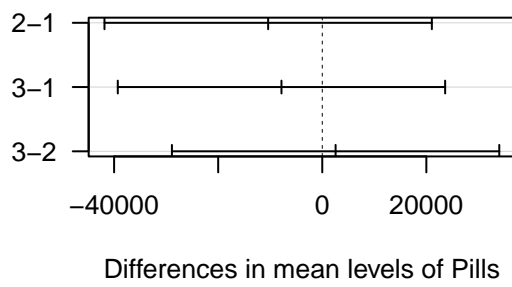
```
##    Tukey multiple comparisons of means
##      95% family-wise confidence level
##
## Fit: aov(formula = Intensity ~ Pills, data = da.178)
##
## $Pills
##             diff       lwr      upr      p adj
## 2-1 -10399.456 -41852.57 21053.66 0.5953923
## 3-1  -7839.010 -39292.13 23614.11 0.7365366
## 3-2   2560.445 -28892.67 34013.56 0.9663840
```
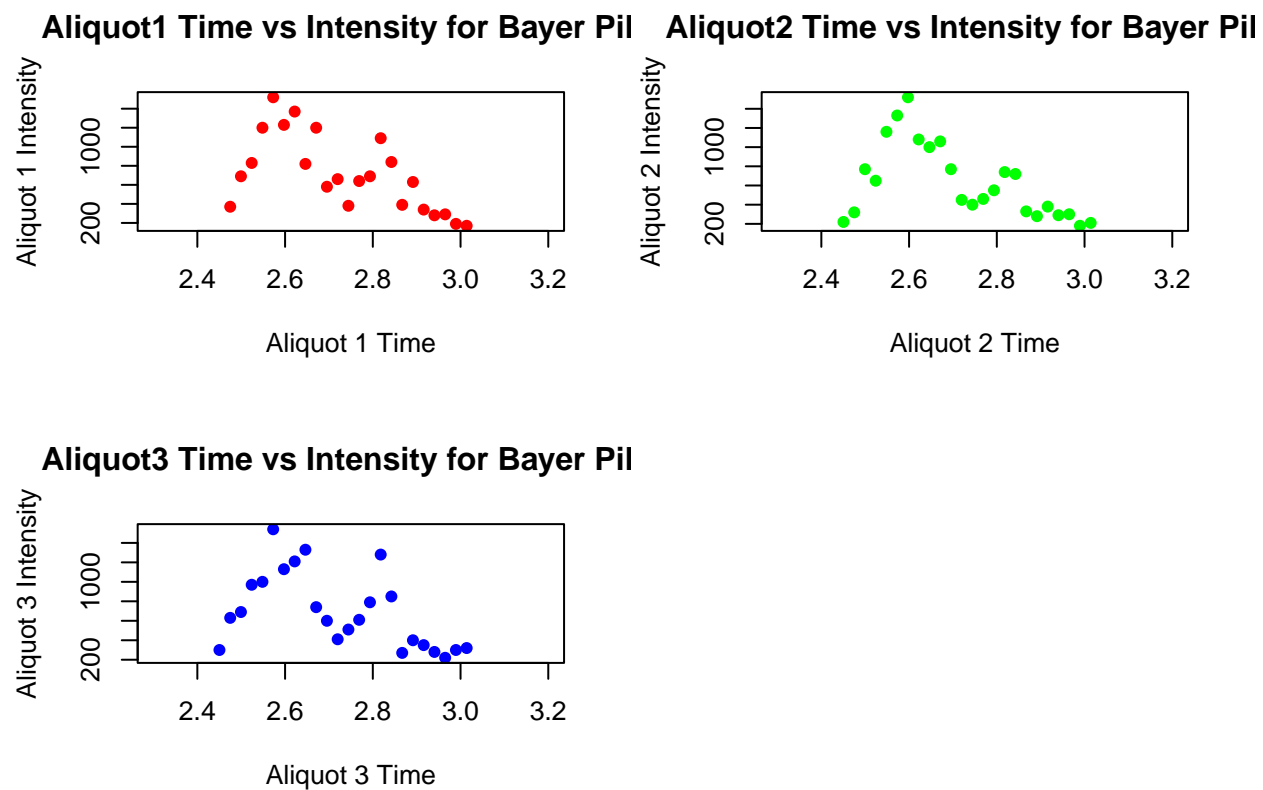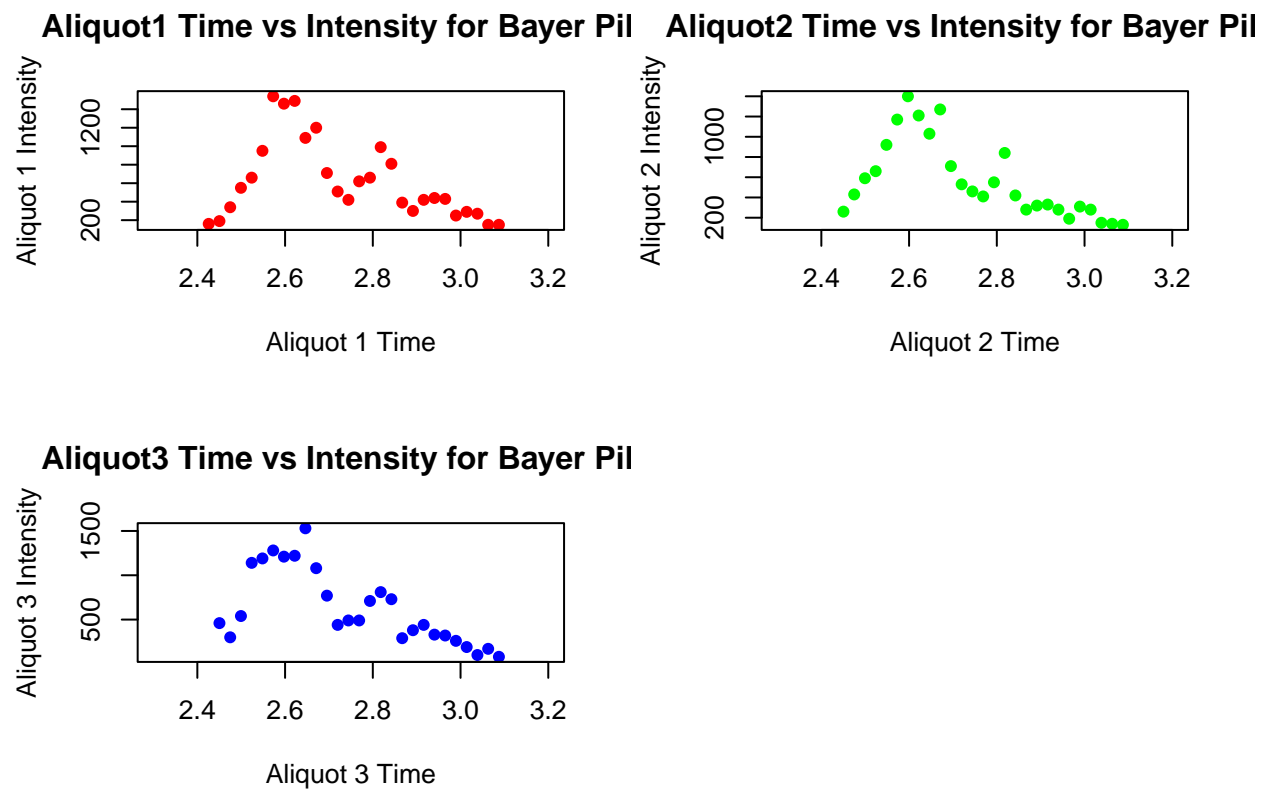
34

**95% family−wise confidence level**



Differences in mean levels of Pills

The p-value of the pills variable is low (p > 0.05), For this peak location, it appears that there are no substantial differences between the tablets. According to the findings of the post-hoc test, there are no statistically significant differences (p > 0.05) between pill groups.

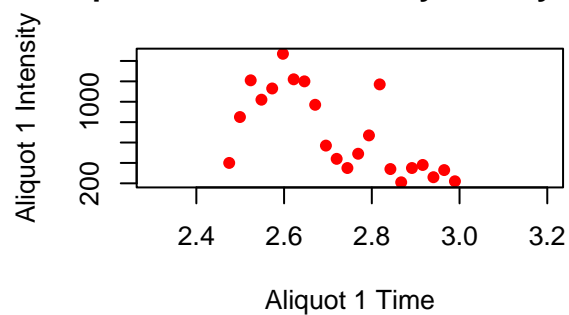Loading Data set for Peak 199.10 91.90
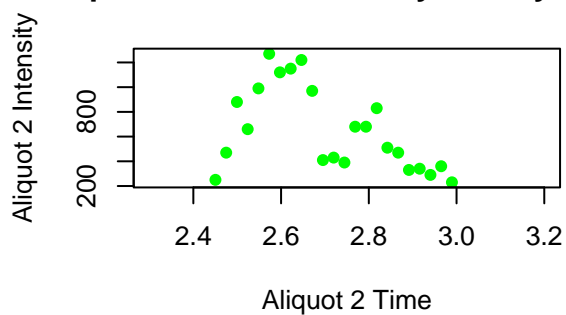
Bayer Pill 1 from Peak 199.10 91.90

**Aliquot1 Time vs Intensity for Bayer Pil**

**Aliquot2 Time vs Intensity for Bayer Pil**

**Aliquot3 Time vs Intensity for Bayer Pil**
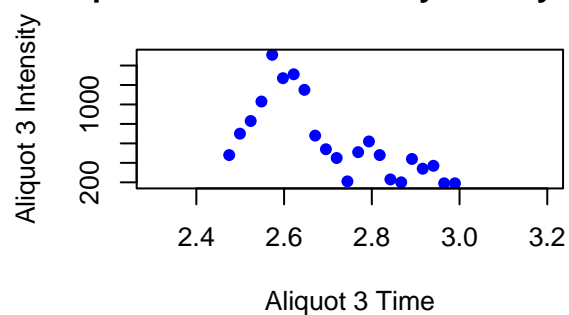
Bayer Pill 2 from Peak 199.10 91.90

## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



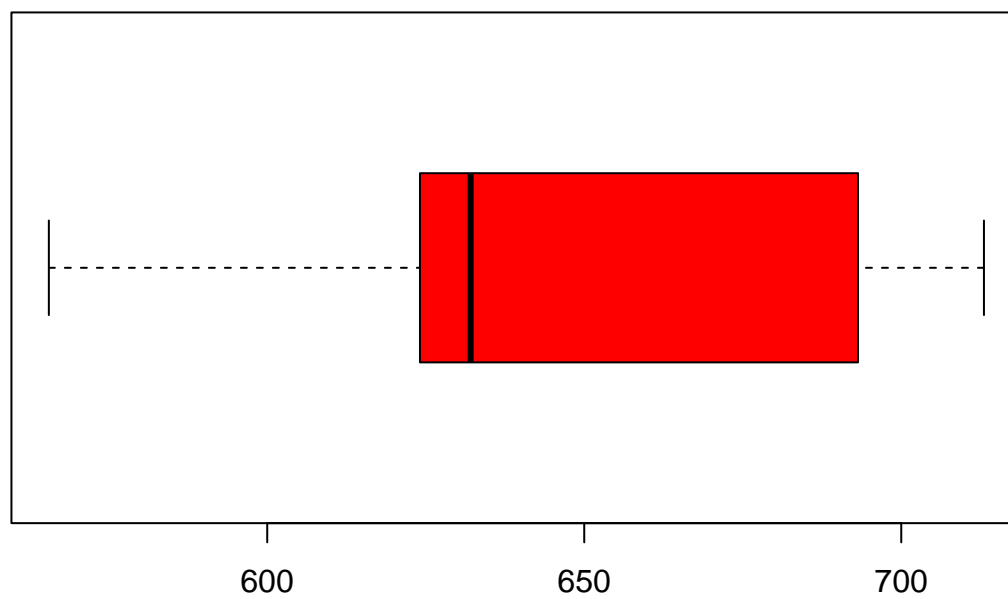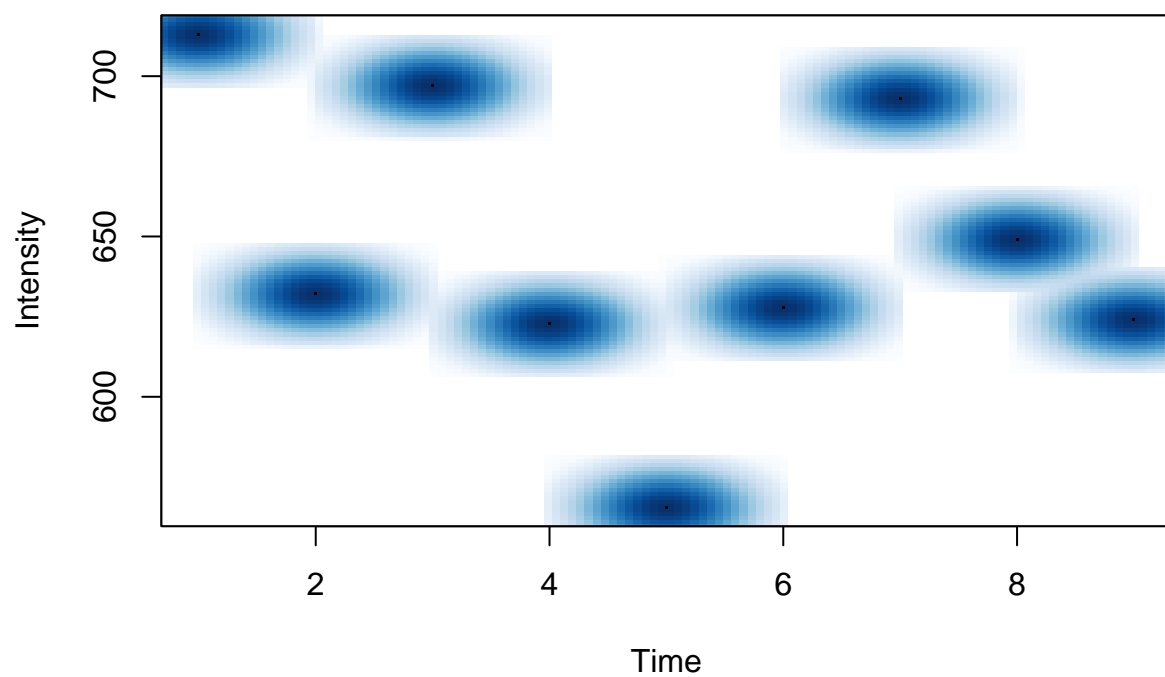## Aliquot3 Time vs Intensity for Bayer Pil



### Bayer Pill 3 from Peak 199.10 91.90

**Aliquot1 Time vs Intensity for Bayer Pil**



**Aliquot2 Time vs Intensity for Bayer Pil**



**Aliquot3 Time vs Intensity for Bayer Pil**



Average Bayer Pill Intensities

Data Visualization for Bayer Pill Peak 199.10 91.90

```
##       BP.199
##  Min.   :565.6
##  1st Qu.:624.1
##  Median :632.1
##  Mean   :647.2
##  3rd Qu.:693.2
##  Max.   :713.0
```
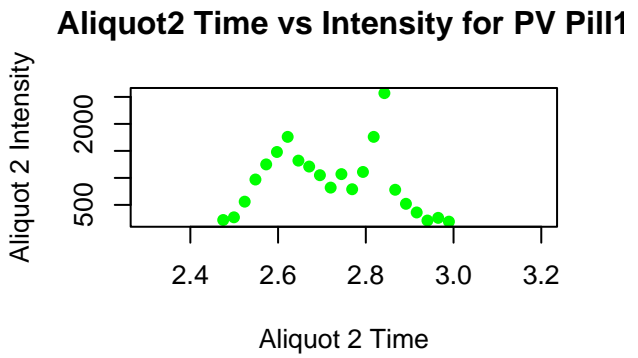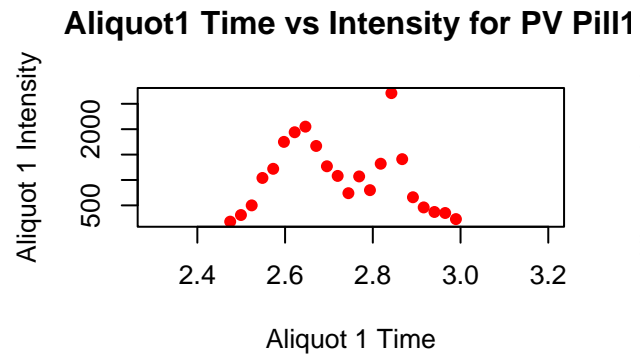
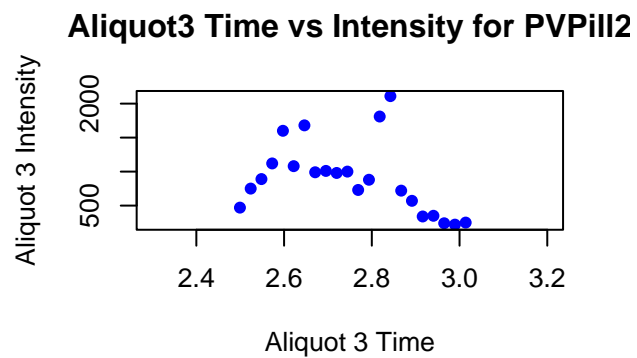**Boxplot of Bayer Pills: Peak 199.10 91.90**

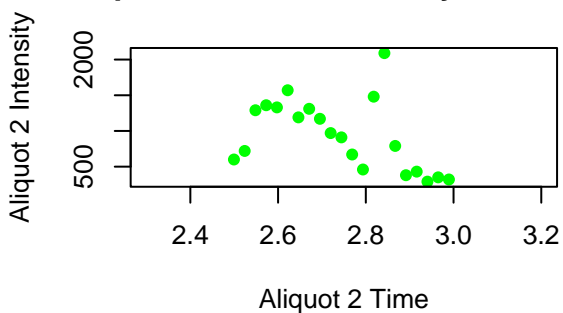# Scatterplot for Bayer Pills from Peak 199.10 91.90

**Aliquot1 Time vs Intensity for PV Pill1**

**Aliquot2 Time vs Intensity for PV Pill1**

**Aliquot3 Time vs Intensity for PV Pill1**

## Aliquot1 Time vs Intensity for PVPill2



## Aliquot2 Time vs Intensity for PVPill2
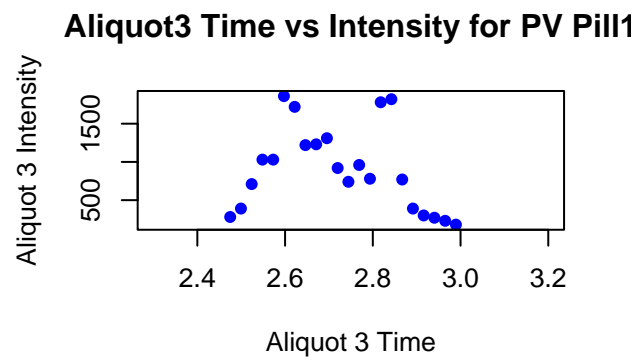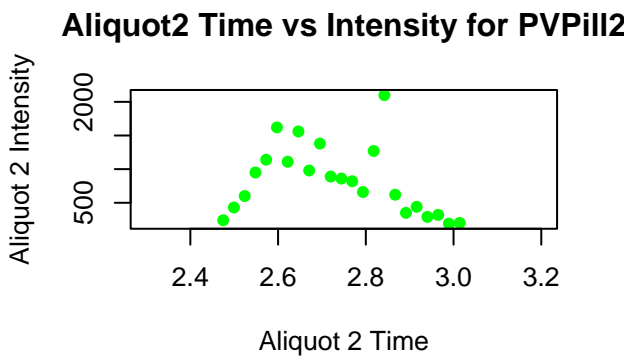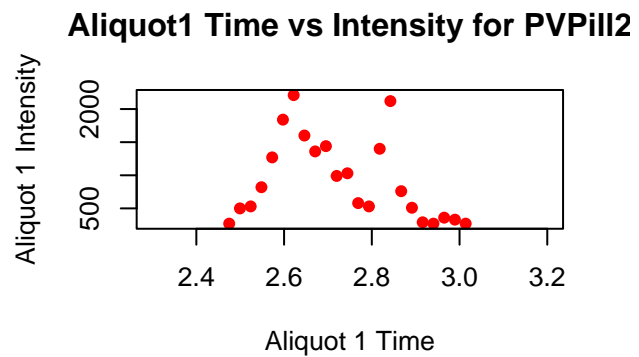


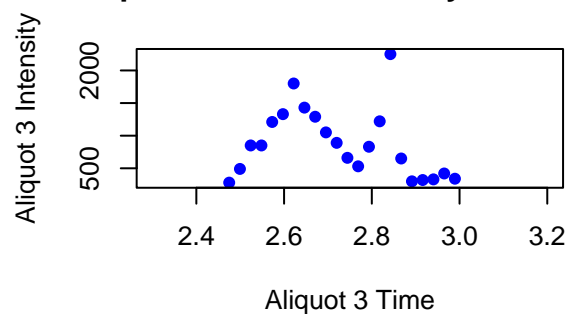## Aliquot3 Time vs Intensity for PVPill2

**Aliquot1 Time vs Intensity for PVPill3**
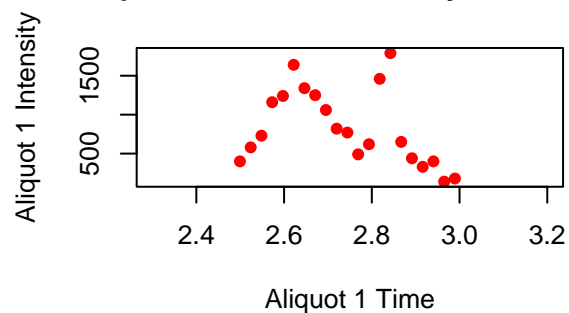


**Aliquot2 Time vs Intensity for PVPill3**



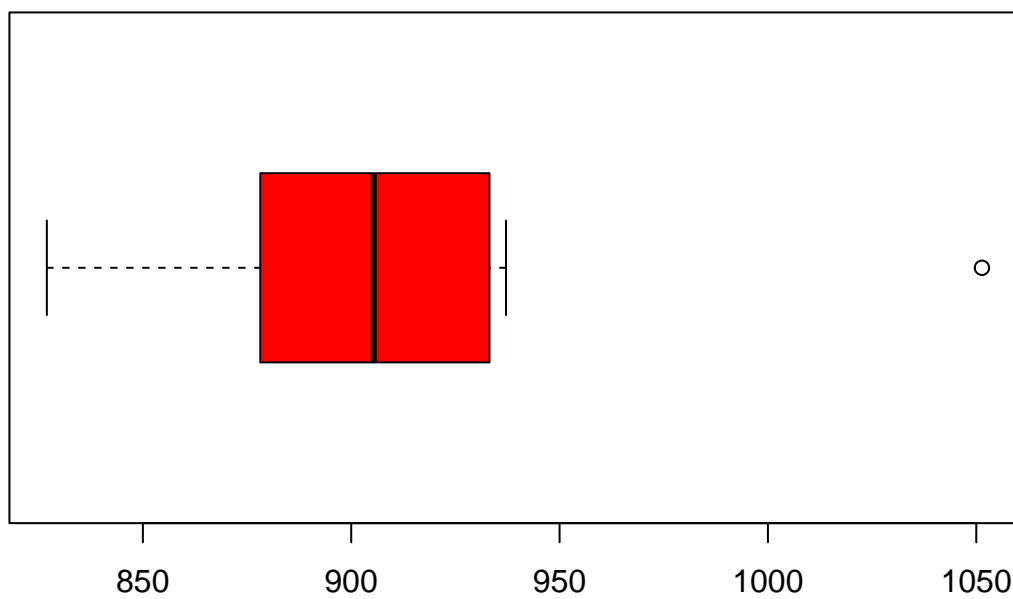**Aliquot3 Time vs Intensity for PVPill3**



## Average P.V Pill Intensities
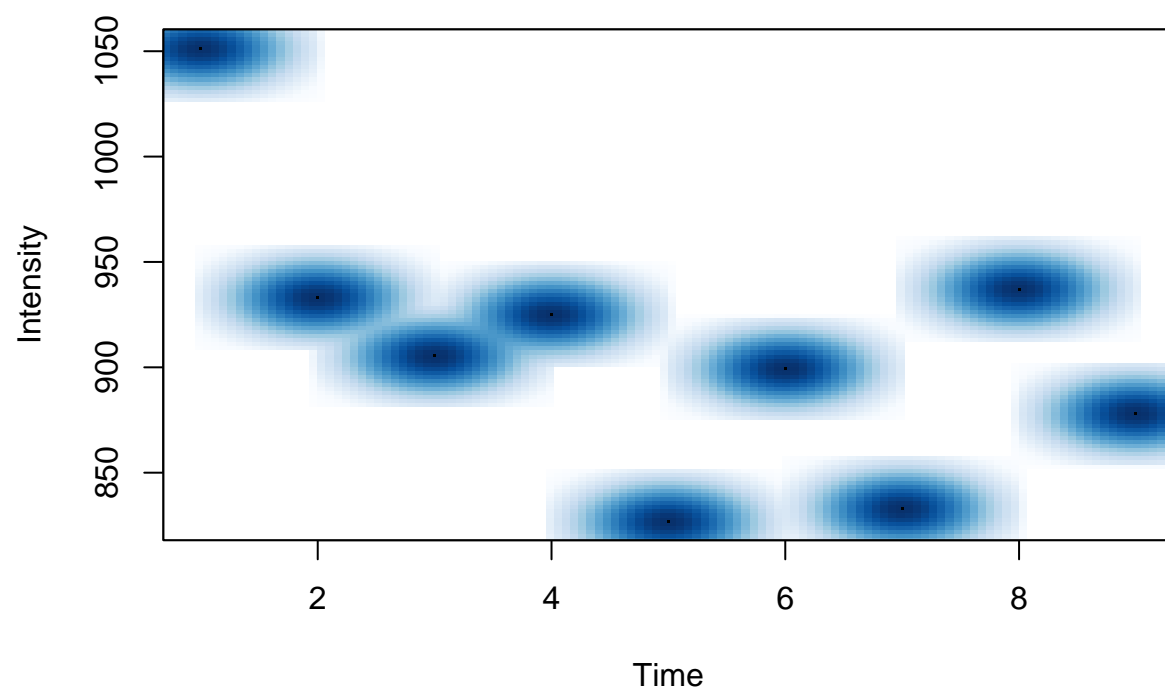
## Data Visualization for PV Pill Peak 199.10 91.90

```
##       PV.199
##  Min.   : 827.0
##  1st Qu.: 878.2
##  Median : 905.5
##  Mean   : 910.0
##  3rd Qu.: 933.2
##  Max.   :1051.4
```
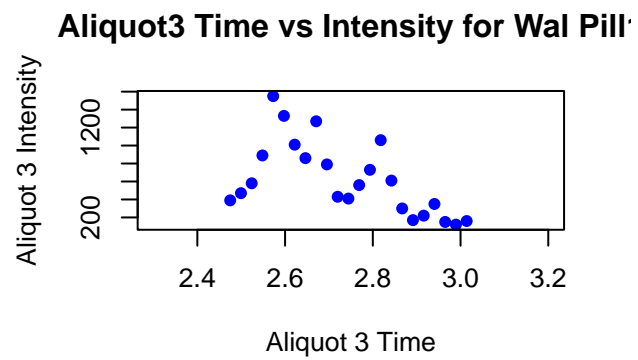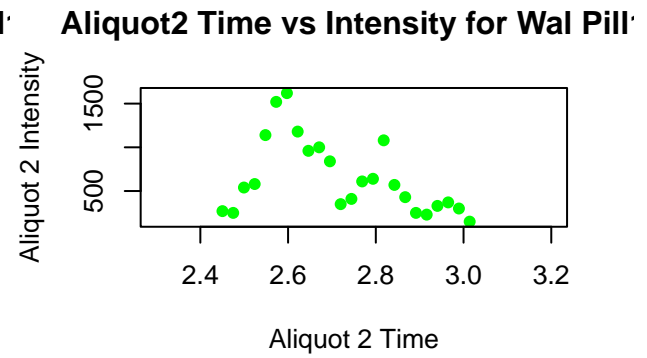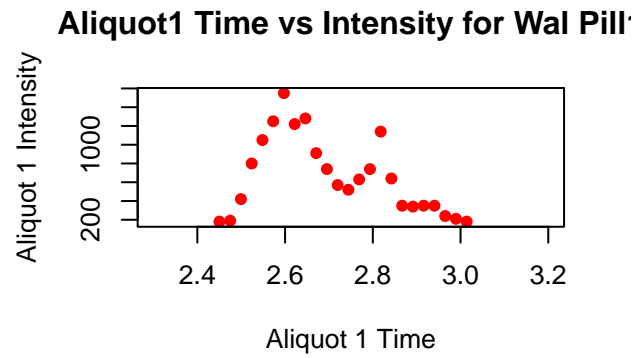
**Boxplot of PV Pills: Peak 199.10 91.90**

**Scatterplot for PV Pills from Peak 199.10 91.90**

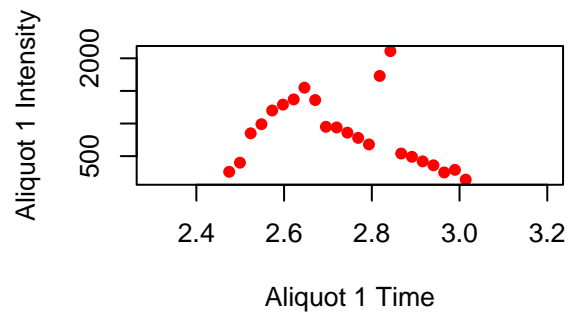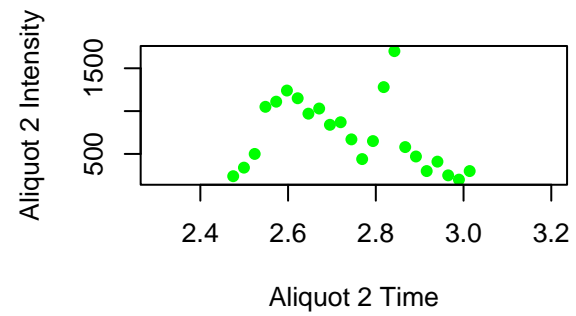**Aliquot1 Time vs Intensity for Wal Pill**

**Aliquot2 Time vs Intensity for Wal Pill**

**Aliquot3 Time vs Intensity for Wal Pill**

**Aliquot1 Time vs Intensity for Wal Pill2**



**Aliquot2 Time vs Intensity for Wal Pill2**



**Aliquot3 Time vs Intensity for Wal Pill2**

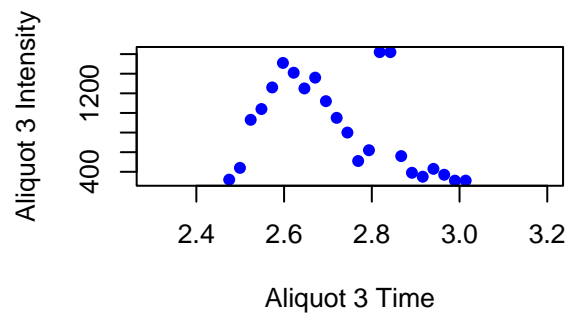**Aliquot1 Time vs Intensity for Wal Pill3**

**Aliquot2 Time vs Intensity for Wal Pill3**

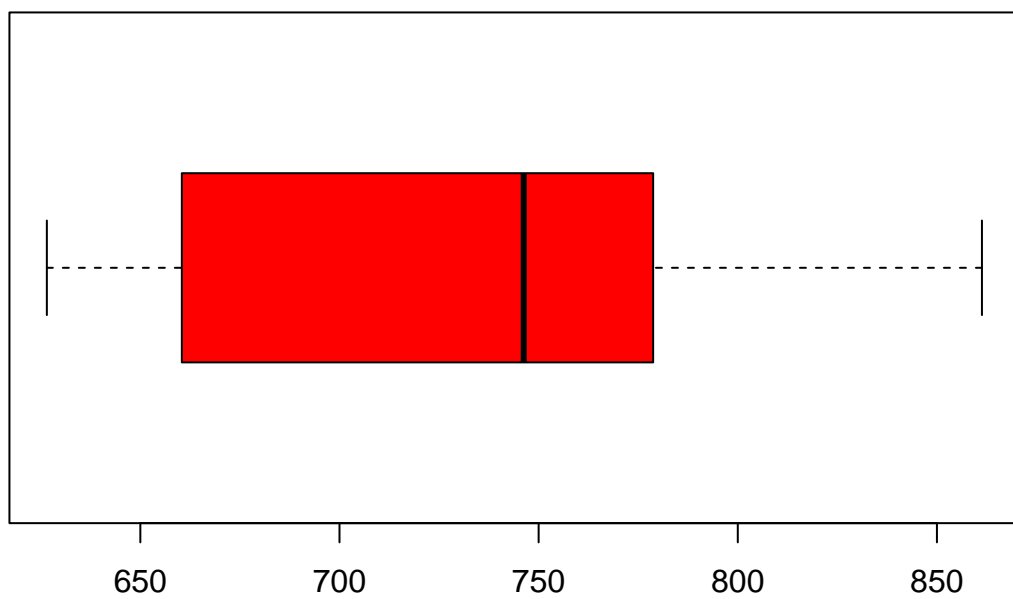**Aliquot3 Time vs Intensity for Wal Pill3**
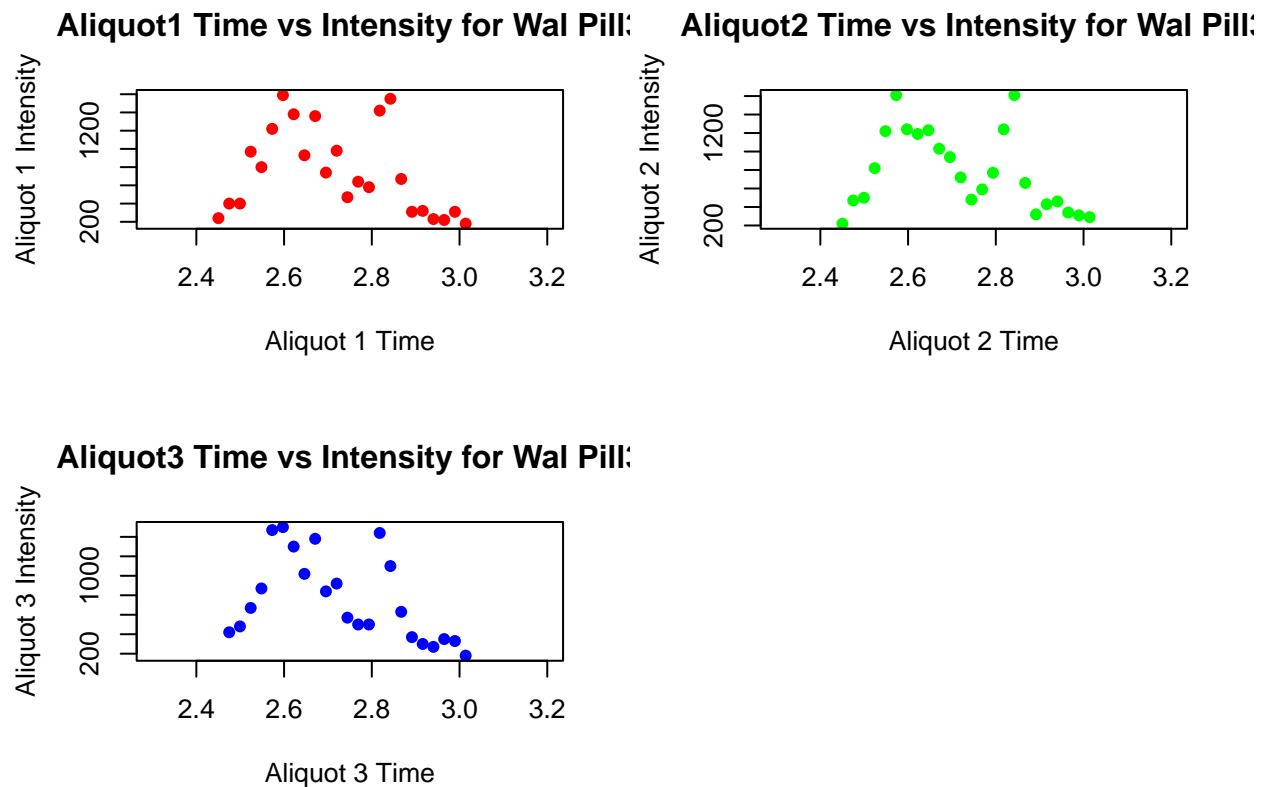
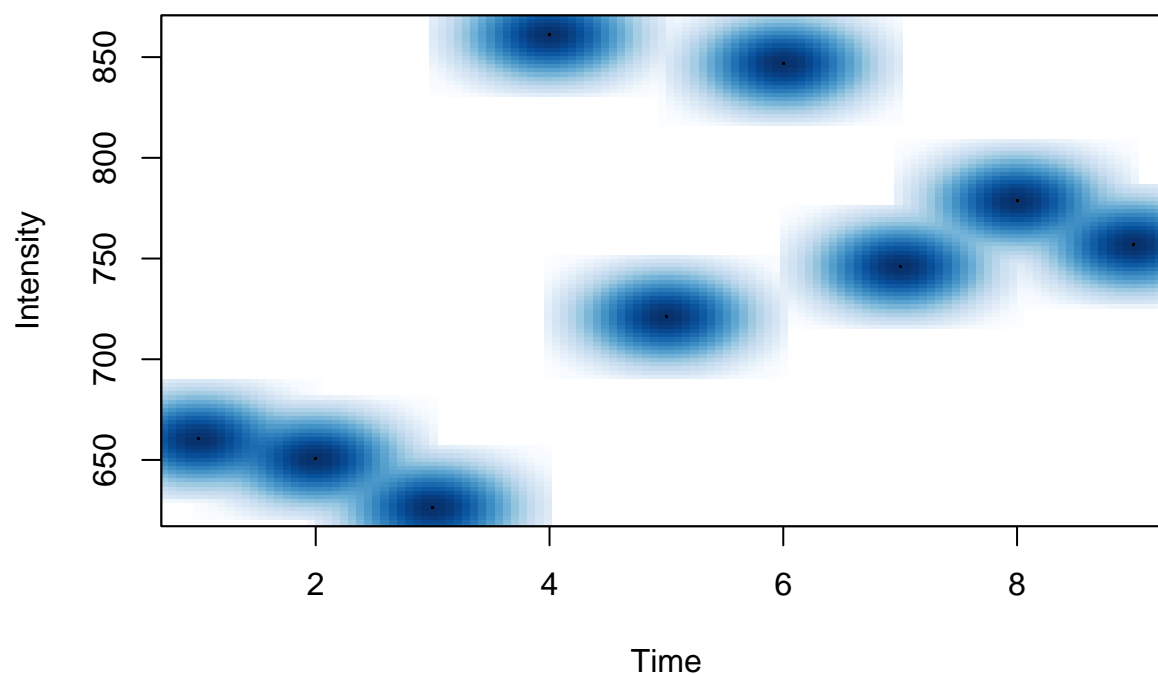## Average Wal Pill Intensities 199.10 91.90

## Data Visualization for Wal Pill Peak 199.10 91.90

```
##      WP.199
## Min.   :626.5
## 1st Qu.:660.4
## Median :746.2
## Mean   :738.8
## 3rd Qu.:778.8
## Max.   :861.3
```

**Boxplot of WP Pills: Peak 199.10 91.90**
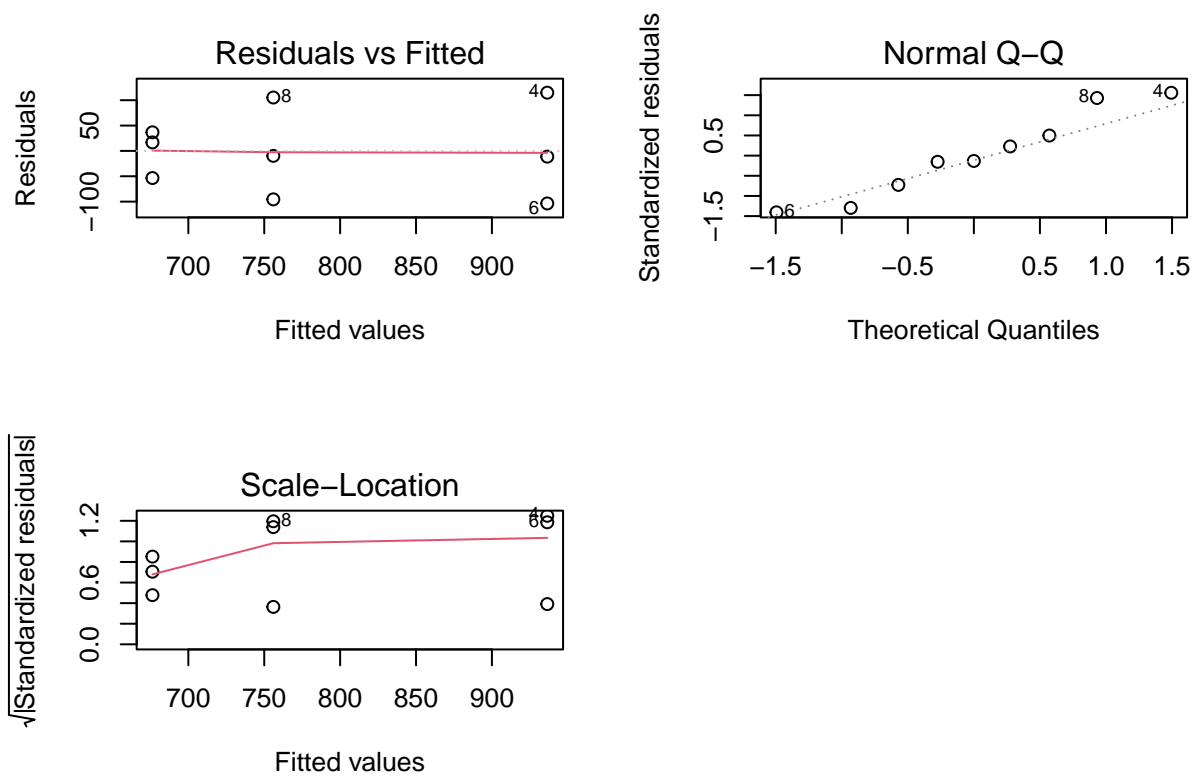
# Scatterplot for WP Pills from Peak 199.10 91.90



Time

## Anova of Peak 199.10 91.90


```
##            Df Sum Sq Mean Sq F value Pr(>F)
## Pills       2 106579   53289   6.542 0.0311 *
## Residuals   6  48874    8146
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```
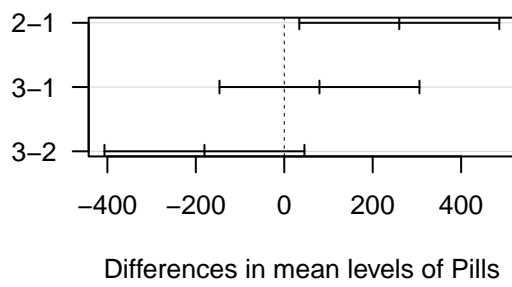
```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Intensity ~ Pills, data = da.199)
##
## $Pills
##            diff        lwr       upr     p adj
## 2-1  260.11858    34.01212  486.2250 0.0286758
## 3-1   79.62953 -146.47693  305.7360 0.5588914
## 3-2 -180.48905 -406.59551   45.6174 0.1089011
```
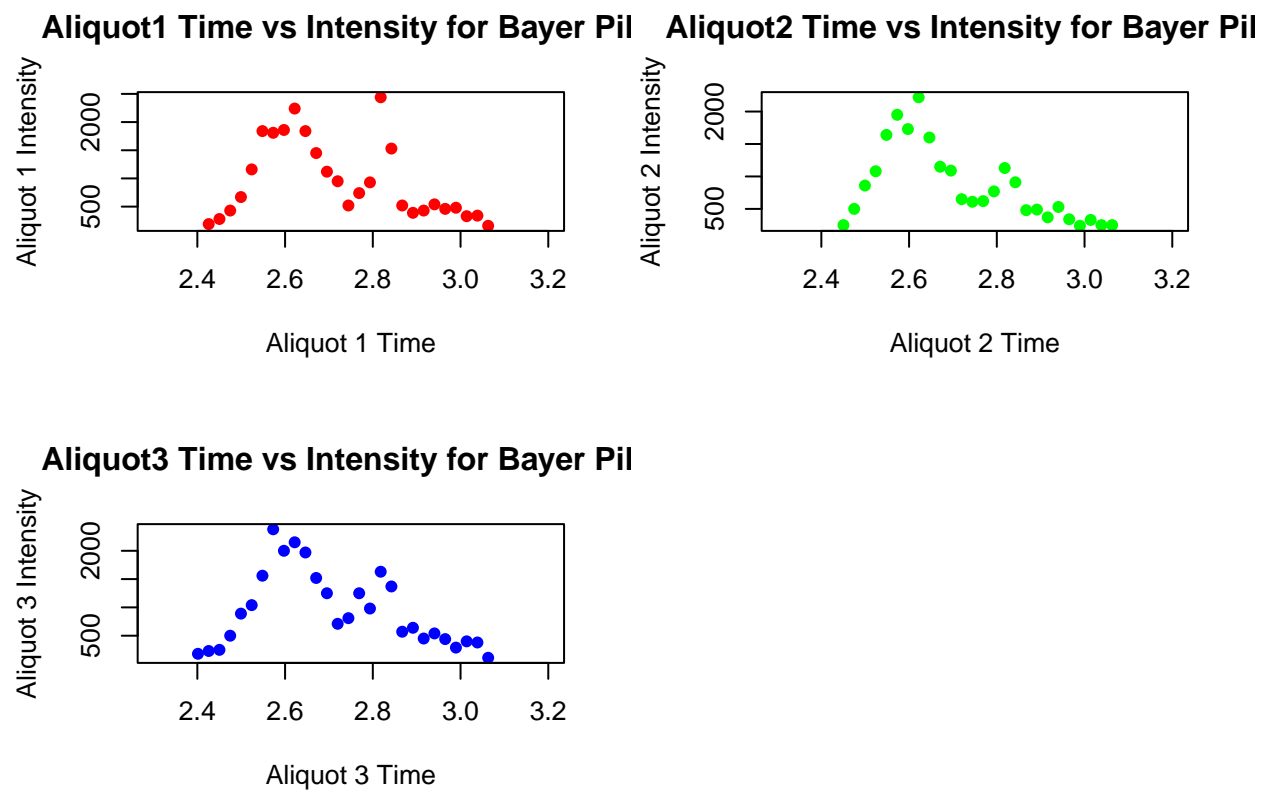
**95% family–wise confidence level**



Differences in mean levels of Pills

The p-value of the pills variable is low (p < 0.05), For this peak location, it appears that there are substantial differences between the tablets. According to the findings of the post-hoc test, We can see that pill groups 2 and 1 have statistically significant differences (p<0.05).

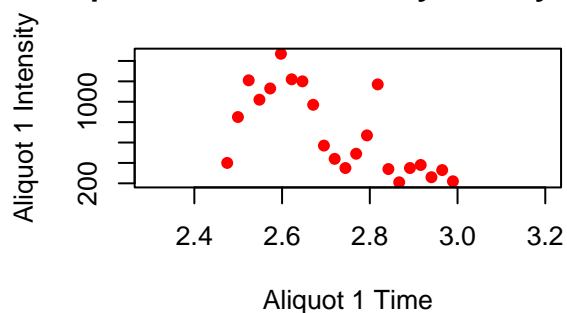Loading Data set for Peak 199.10 92.90

Bayer Pill 1 from Peak 199.10 92.90
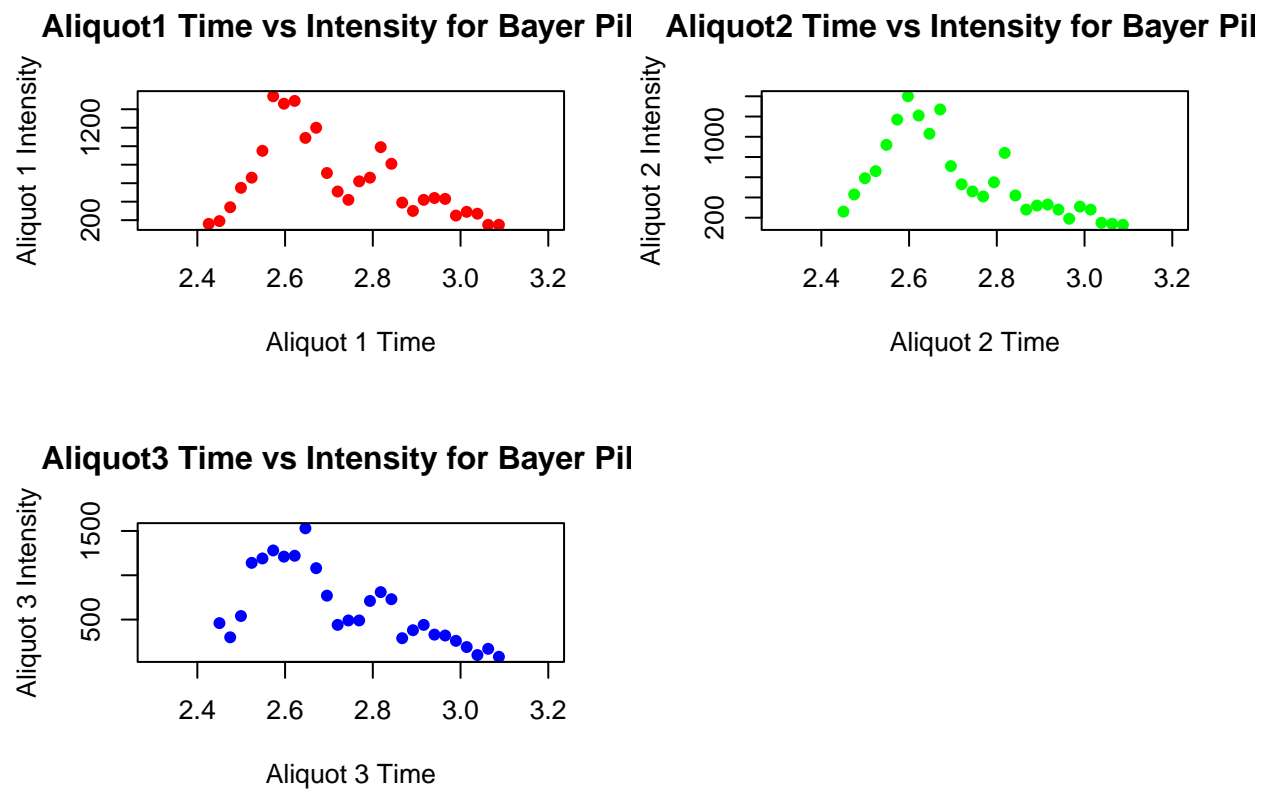
**Aliquot1 Time vs Intensity for Bayer Pil**



**Aliquot2 Time vs Intensity for Bayer Pil**
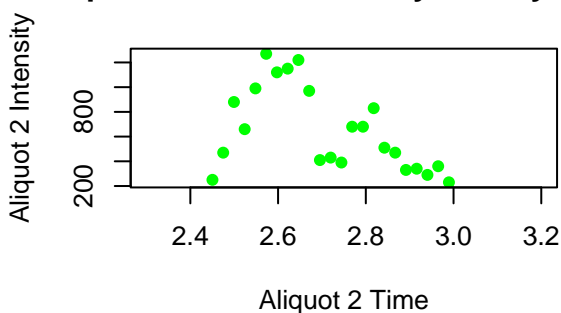


**Aliquot3 Time vs Intensity for Bayer Pil**

Bayer Pill 2 from Peak 199.10 92.90

## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



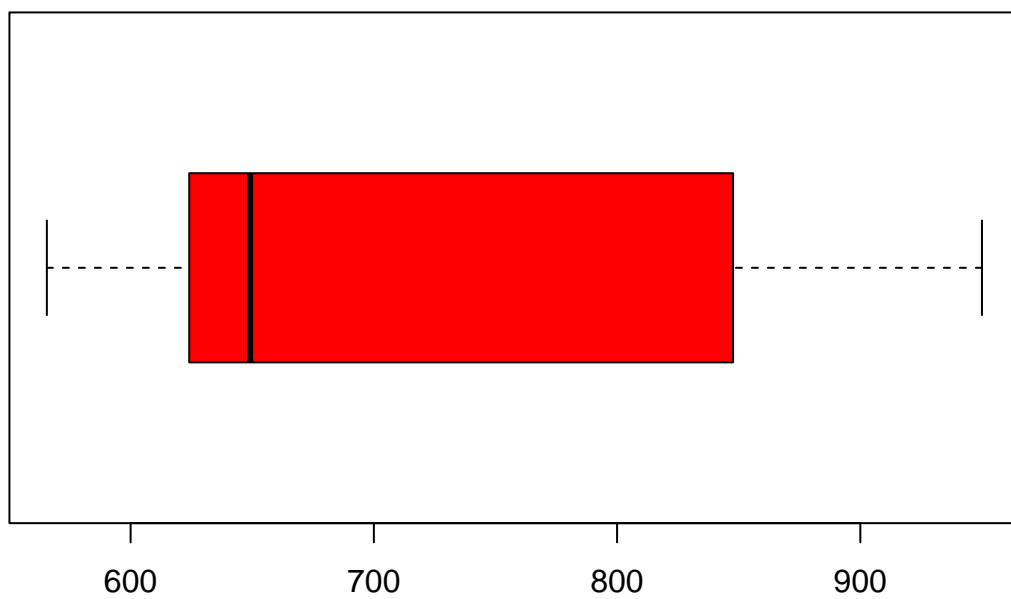## Aliquot3 Time vs Intensity for Bayer Pil



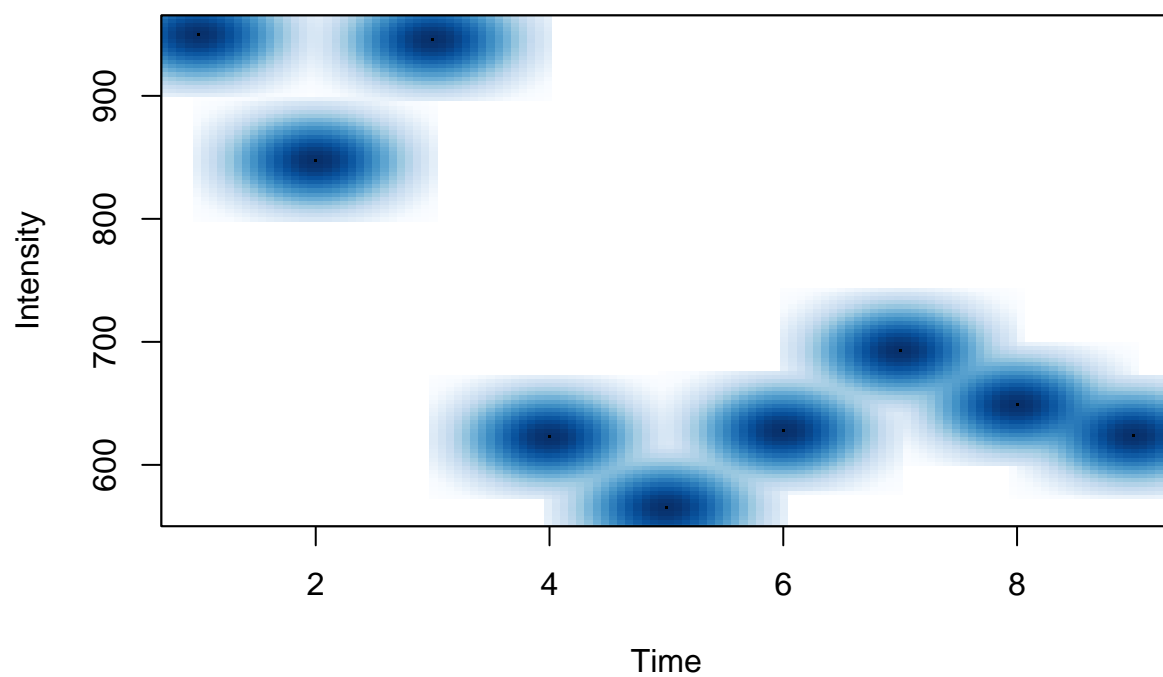### Bayer Pill 3 from Peak 199.10 92.90

## Aliquot1 Time vs Intensity for Bayer Pil



Aliquot 1 Time

## Aliquot2 Time vs Intensity for Bayer Pil



Aliquot 2 Time

## Aliquot3 Time vs Intensity for Bayer Pil



Aliquot 3 Time
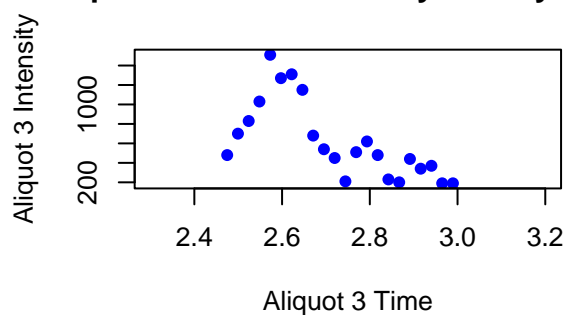
Average Bayer Pill Intensities

Data Visualization for Bayer Pill Peak 199.10 91.90

```
##       BP.92
## Min.   :565.6
## 1st Qu.:624.1
## Median :649.1
## Mean   :725.2
## 3rd Qu.:847.7
## Max.   :950.0
```
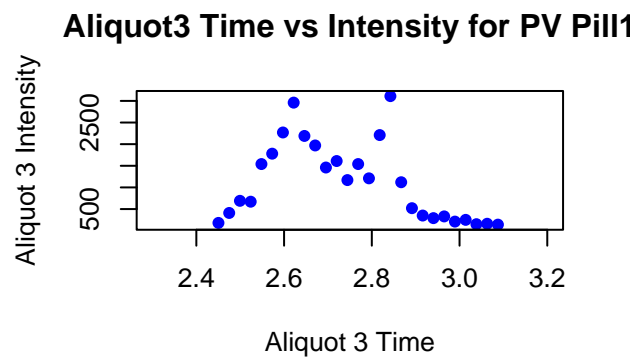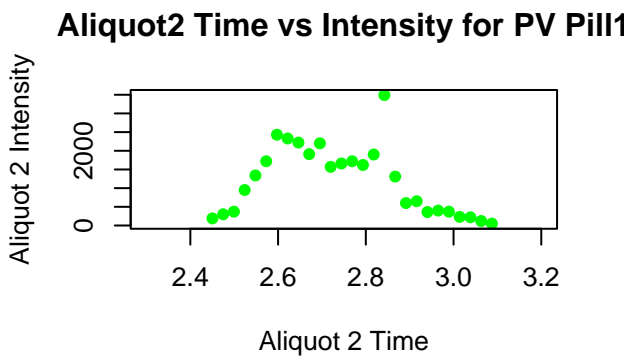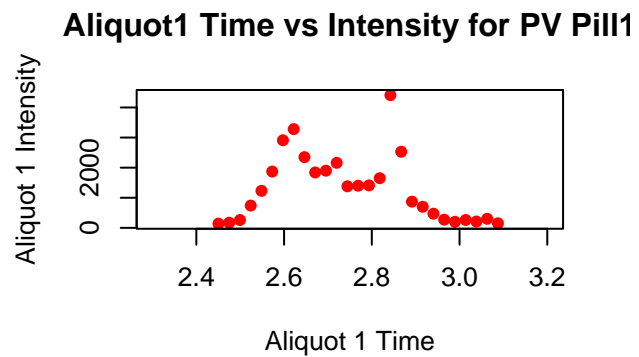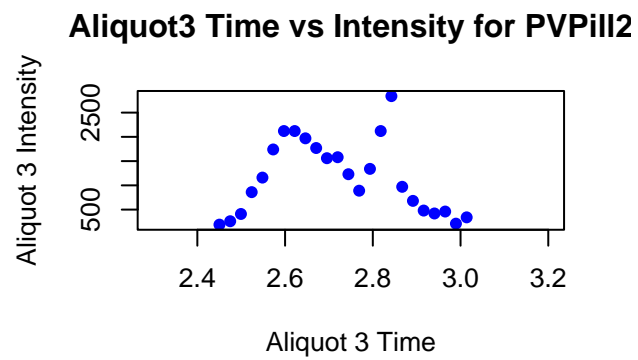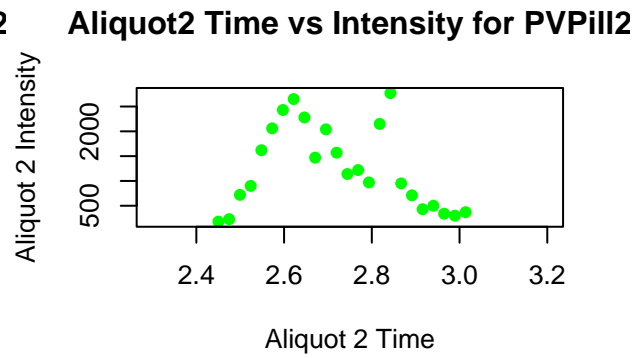
# Boxplot of Bayer Pills: Peak 199.10 91.90

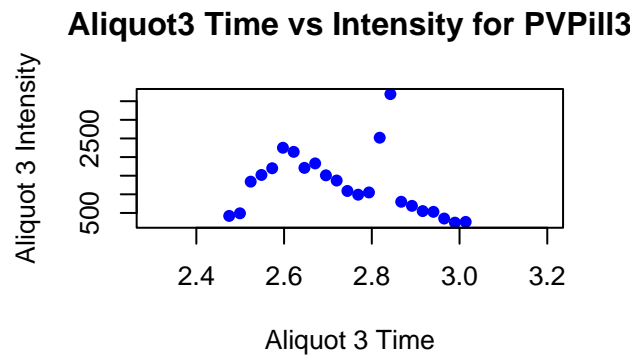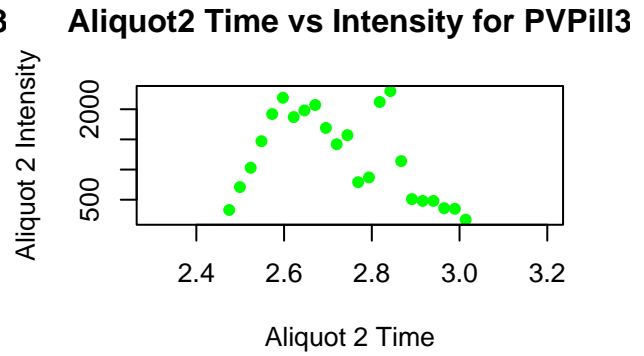# Scatterplot for Bayer Pills from Peak 199.10 91.90

**Aliquot1 Time vs Intensity for PV Pill1**

**Aliquot2 Time vs Intensity for PV Pill1**

**Aliquot3 Time vs Intensity for PV Pill1**

**Aliquot1 Time vs Intensity for PVPill2**

**Aliquot2 Time vs Intensity for PVPill2**

**Aliquot3 Time vs Intensity for PVPill2**

**PV 3 Pill from Peak 199.10 92.90**

**Aliquot1 Time vs Intensity for PVPill3**



**Aliquot2 Time vs Intensity for PVPill3**



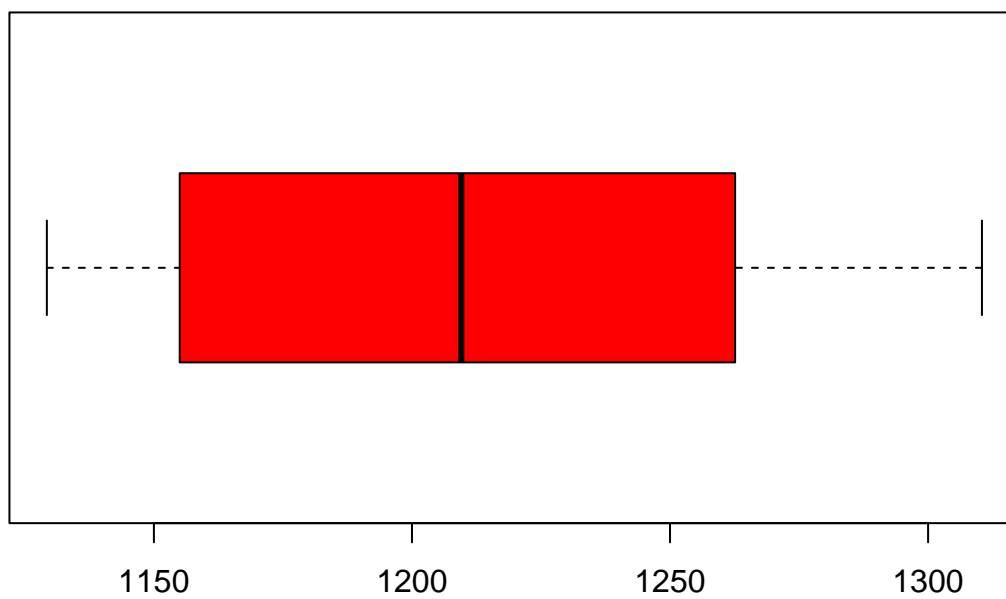**Aliquot3 Time vs Intensity for PVPill3**
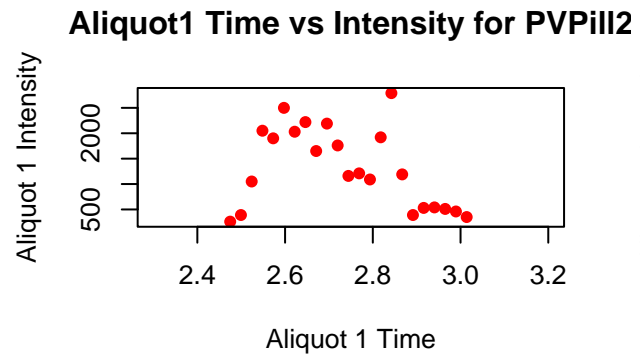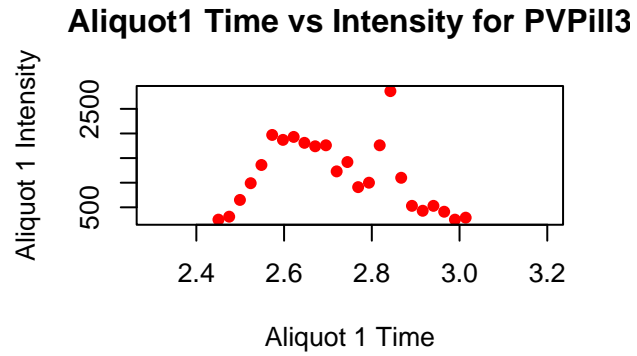


**Average P.V Pill Intensities**
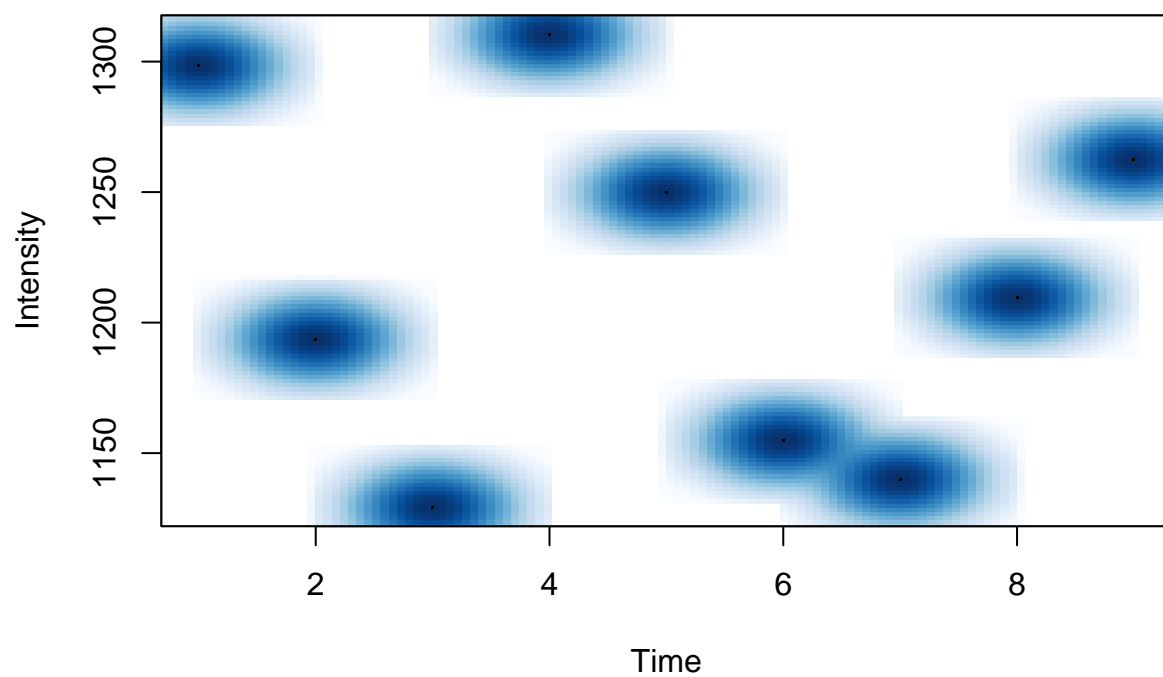
**Data Visualization for PV Pill Peak 199.10 92.90**

```
##       PV.92
##  Min.   :1129
##  1st Qu.:1155
##  Median :1210
##  Mean   :1217
##  3rd Qu.:1263
##  Max.   :1310
```
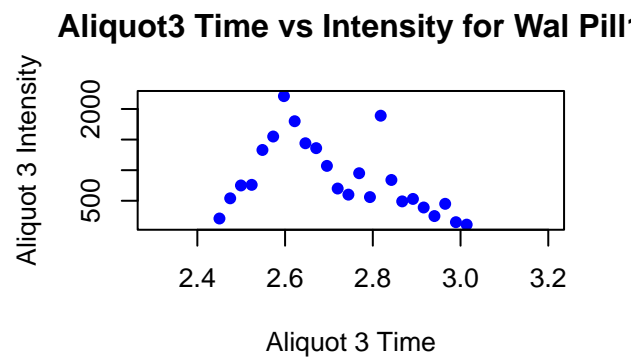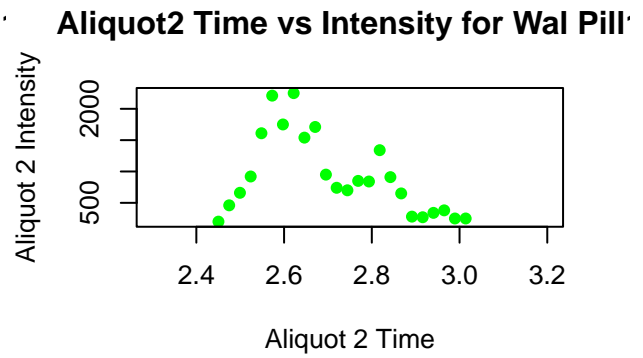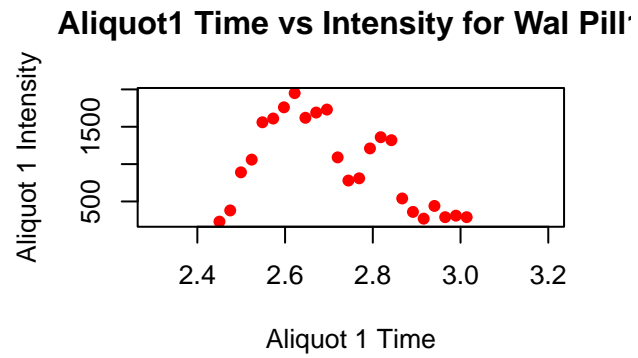
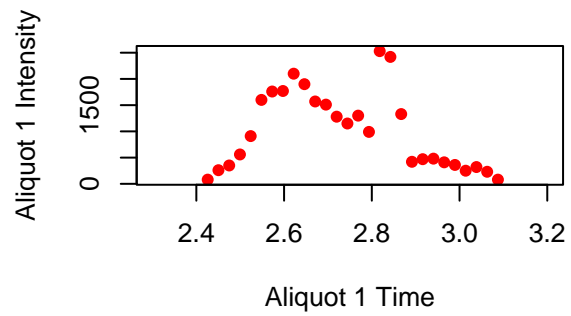**Boxplot of PV Pills: Peak 199.10 92.90**

**Scatterplot for PV Pills from Peak 199.10 92.90**

Wal Pill 1 from Peak 199.10 92.90

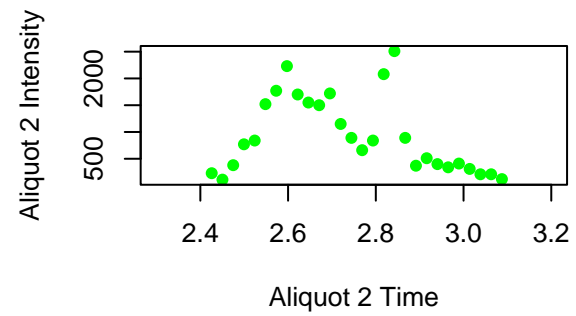**Aliquot1 Time vs Intensity for Wal Pill**



Aliquot 1 Time

**Aliquot2 Time vs Intensity for Wal Pill**



Aliquot 2 Time

**Aliquot3 Time vs Intensity for Wal Pill**



Aliquot 3 Time

63

**Aliquot1 Time vs Intensity for Wal Pill2**



**Aliquot2 Time vs Intensity for Wal Pill2**



**Aliquot3 Time vs Intensity for Wal Pill2**

**Aliquot1 Time vs Intensity for Wal Pill3**



**Aliquot2 Time vs Intensity for Wal Pill3**



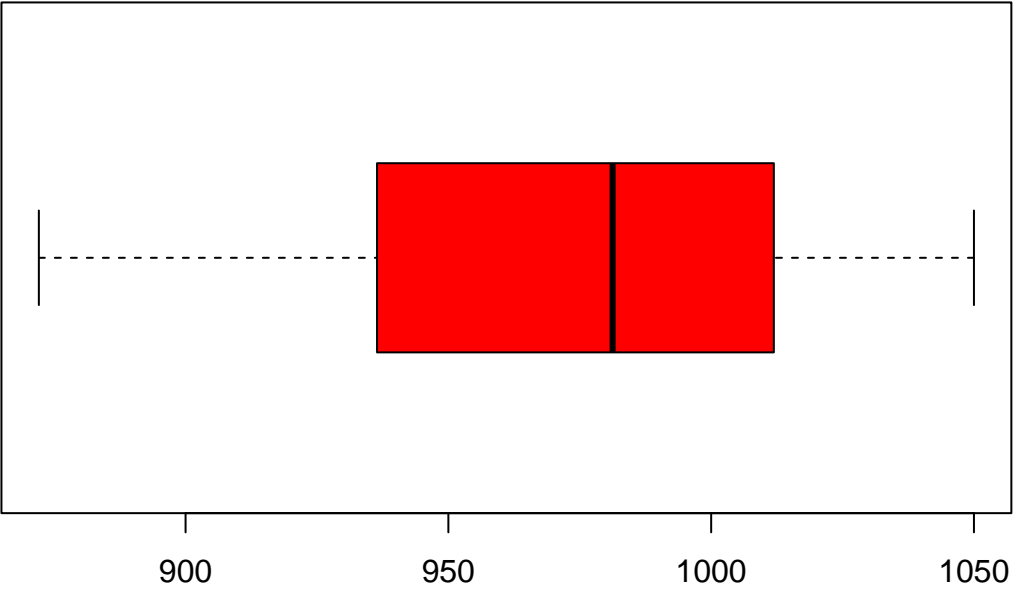**Aliquot3 Time vs Intensity for Wal Pill3**
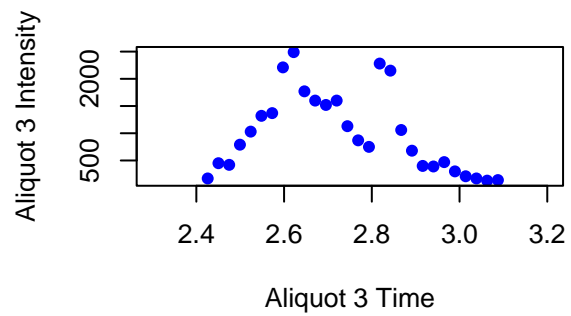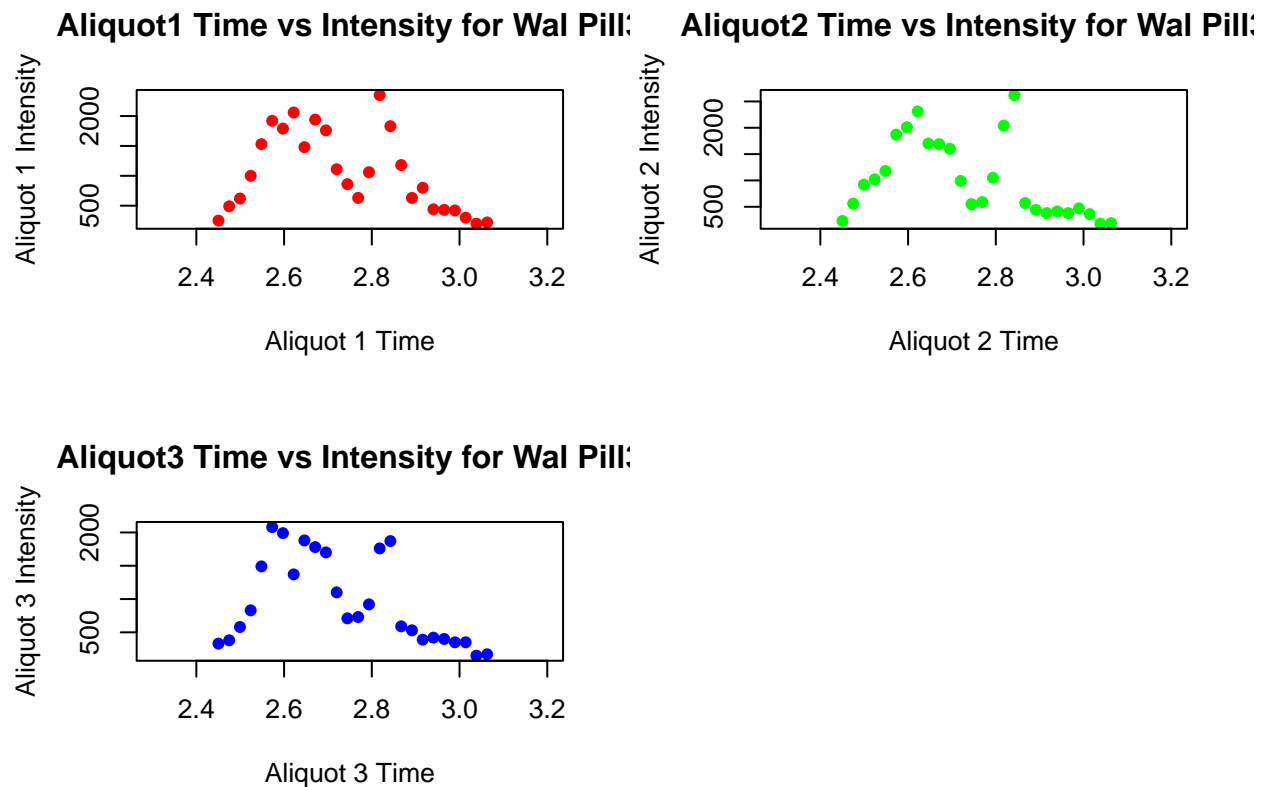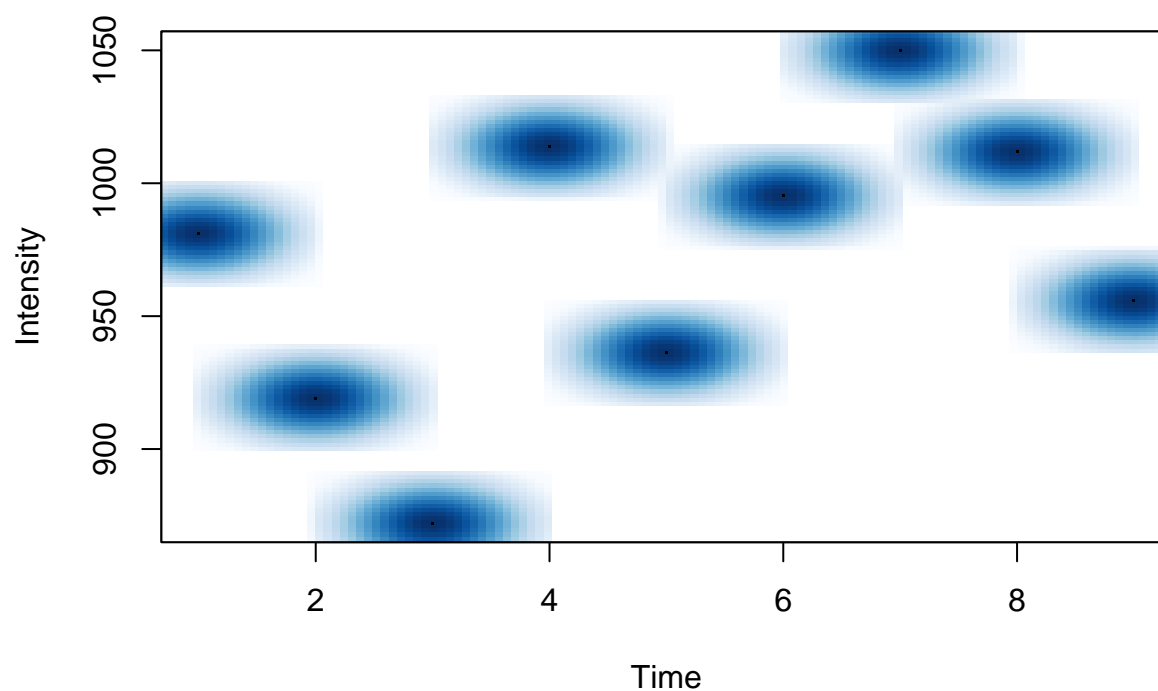


## Average Wal Pill Intensities

## Data Visualization for Wal Pill Peak 199.10 92.90

```
##       WP.92
## Min.   : 872.1
## 1st Qu.: 936.4
## Median : 981.2
## Mean   : 970.7
## 3rd Qu.:1011.9
## Max.   :1050.0
```

**Boxplot of WP Pills: Peak 199.10 92.90**
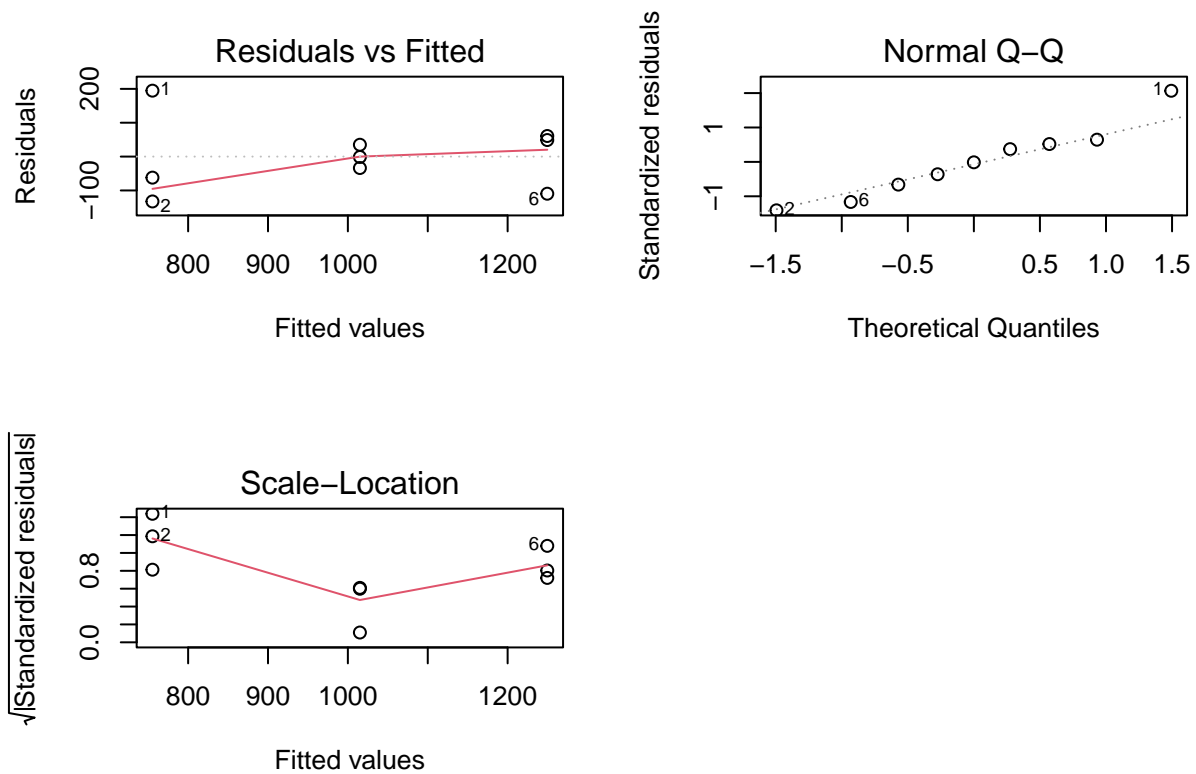
**Scatterplot for WP Pills from Peak 199.10 92.90**



## Anova of Peak 199.10 92.90


```
##              Df Sum Sq Mean Sq F value Pr(>F)
## Pills         2 366821  183411   13.79 0.0057 **
## Residuals     6  79779   13297
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```
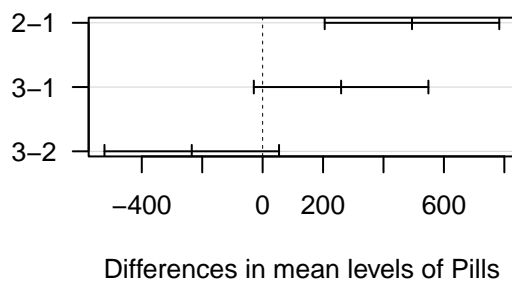
## Residuals vs Fitted



## Normal Q–Q



## Scale–Location



```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Intensity ~ Pills, data = da.92)
##
## $Pills
##          diff        lwr       upr     p adj
## 2-1  494.3048  205.42474 783.18482 0.0046153
## 3-1  259.7132  -29.16683 548.59324 0.0735582
## 3-2 -234.5916 -523.47161  54.28846 0.1031684
```
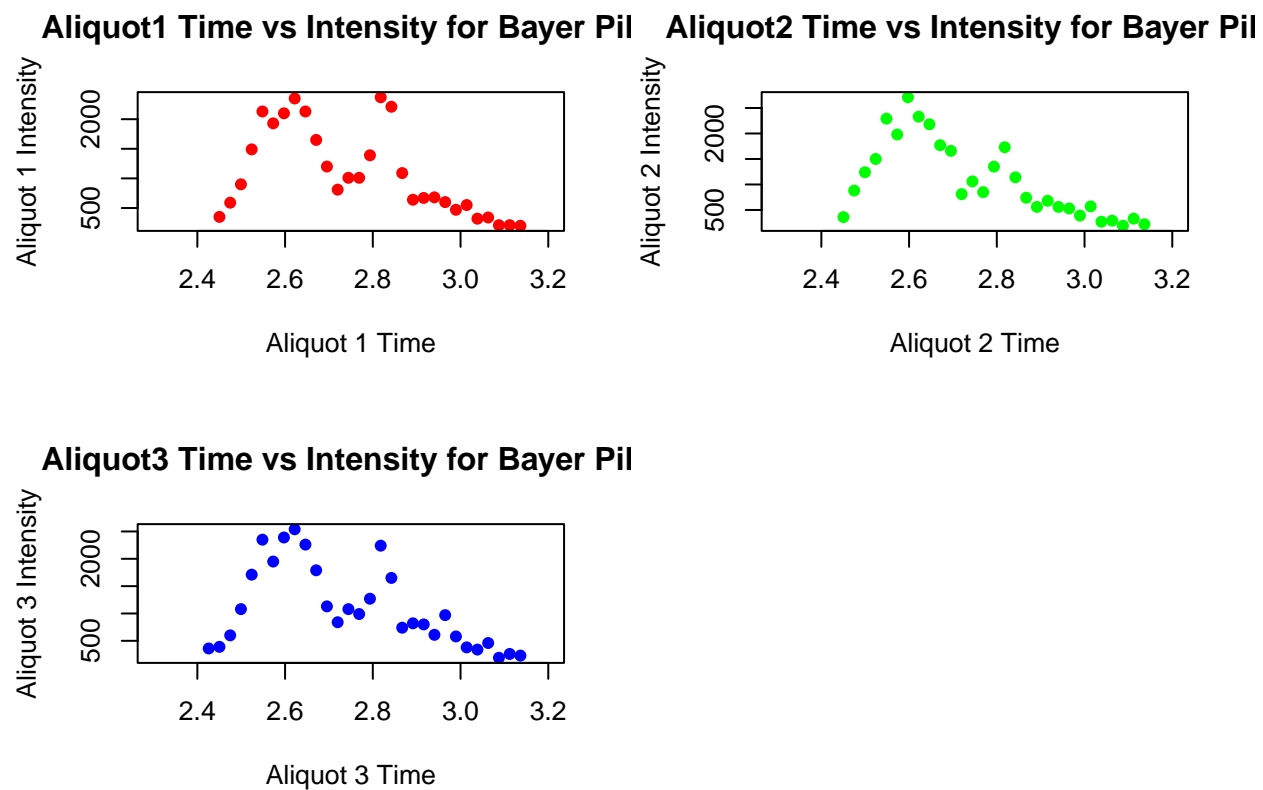
**95% family–wise confidence level**
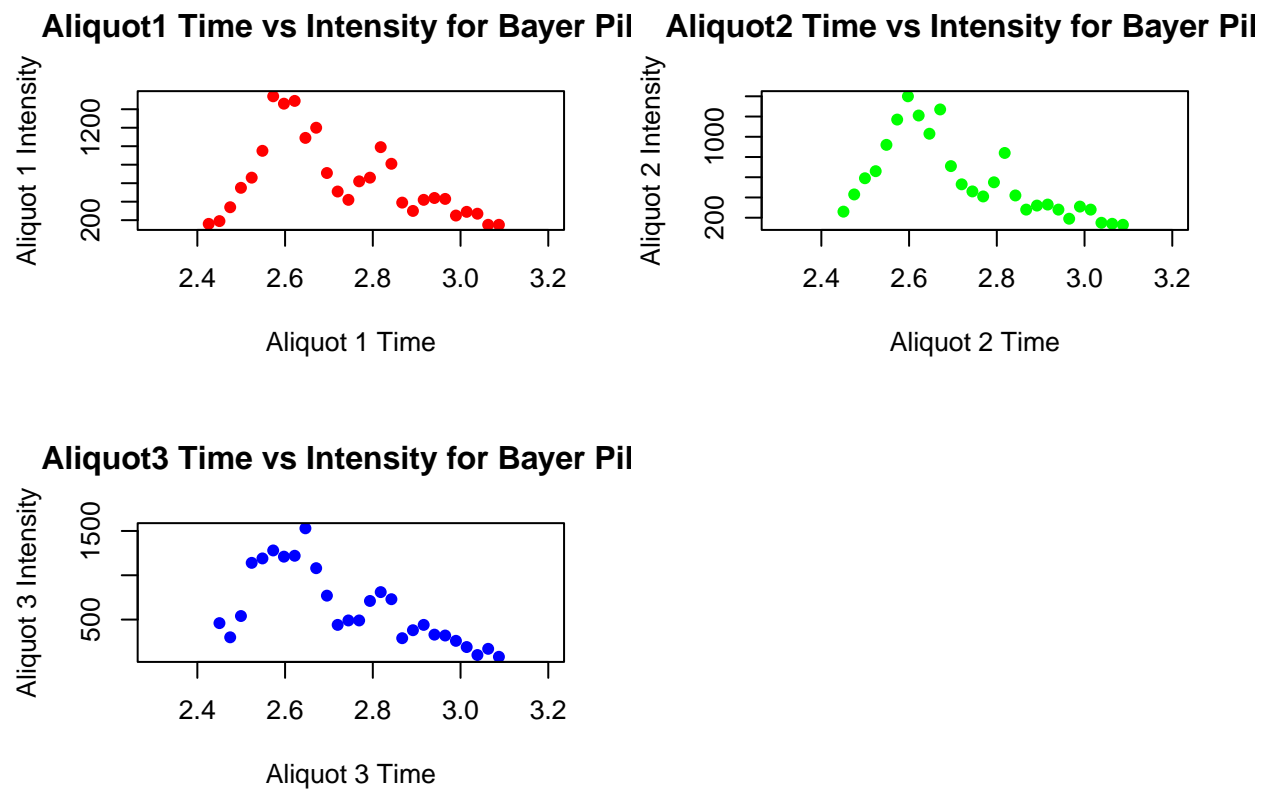


Differences in mean levels of Pills

The p-value of the pills variable is low (p $<$ 0.05), For this peak location, it appears that there are substantial differences between the tablets. According to the findings of the post-hoc test,We can see that pill groups 2 and 1 have statistically significant differences (p$<$0.05). Also We can see that pill groups 3 and 1 have statistically significant differences (p$<$0.05).

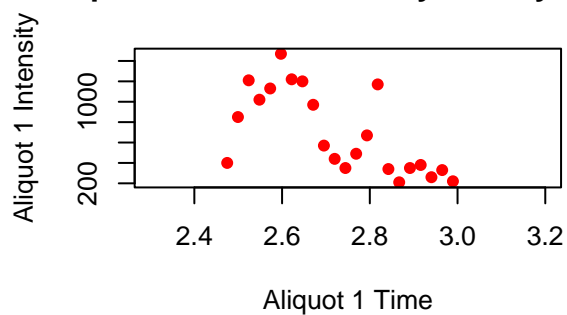Loading Data set for Peak 199.10 137.00

Bayer Pill 1 from Peak 199.10 137.00

**Aliquot1 Time vs Intensity for Bayer Pil**



Aliquot 1 Time

**Aliquot2 Time vs Intensity for Bayer Pil**



Aliquot 2 Time

**Aliquot3 Time vs Intensity for Bayer Pil**
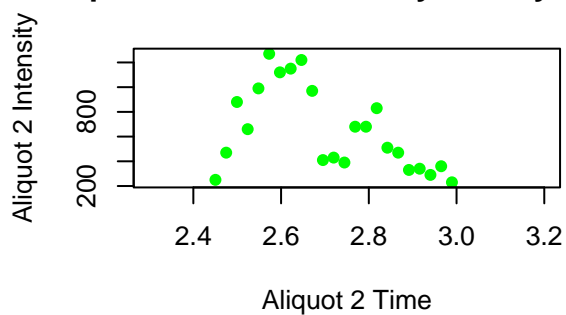


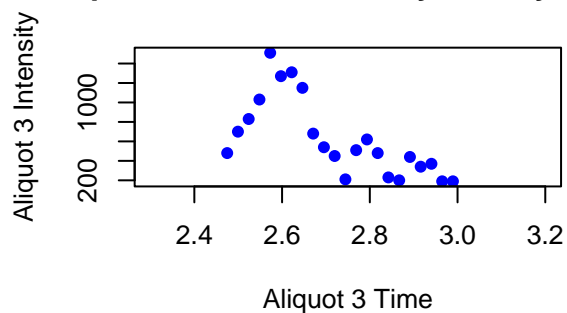Aliquot 3 Time

Bayer Pill 2 from Peak 199.10 137.00

### Aliquot1 Time vs Intensity for Bayer Pil



### Aliquot2 Time vs Intensity for Bayer Pil



### Aliquot3 Time vs Intensity for Bayer Pil



### Bayer Pill 3 from Peak 199.10 137.00

**Aliquot1 Time vs Intensity for Bayer Pil**



**Aliquot2 Time vs Intensity for Bayer Pil**



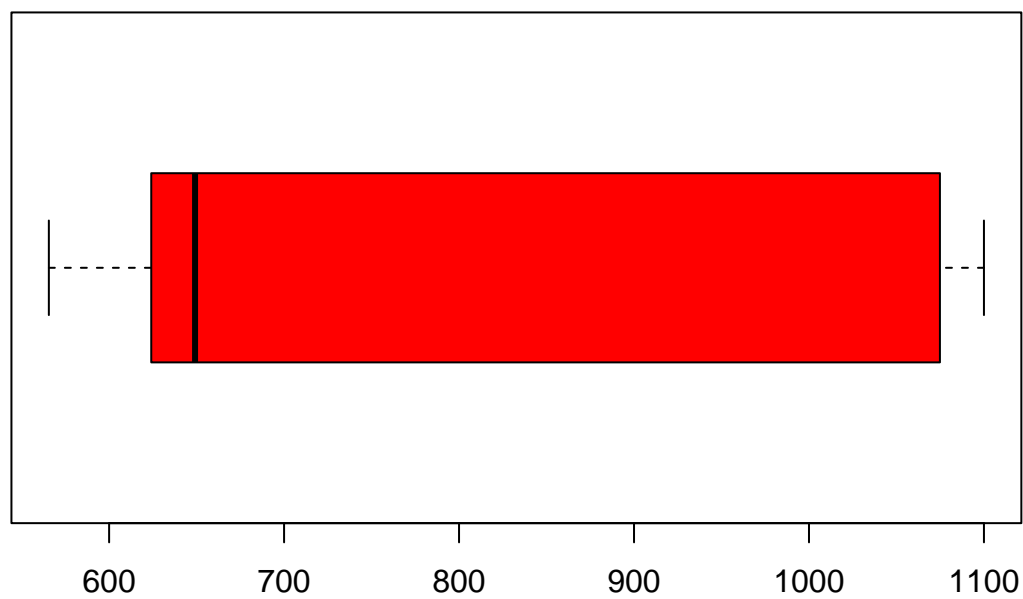**Aliquot3 Time vs Intensity for Bayer Pil**
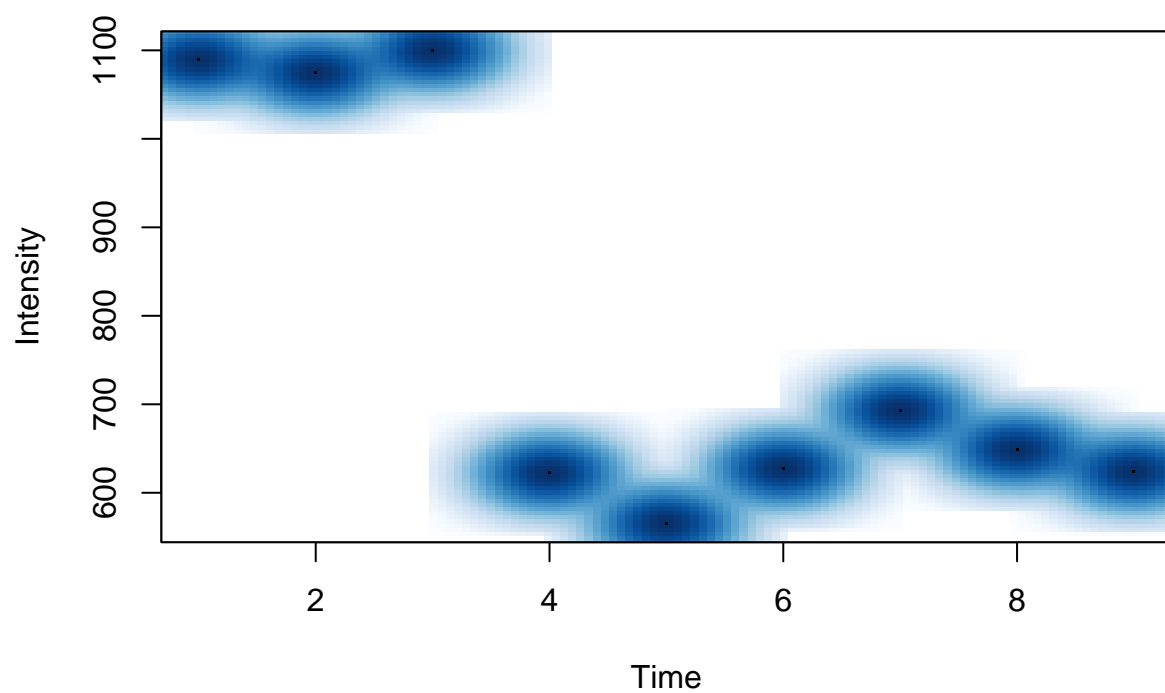


Average Bayer Pill Intensities

Data Visualization for Bayer Pill Peak 199.10 91.90

```
##         BPa
##  Min.   : 565.6
##  1st Qu.: 624.1
##  Median : 649.1
##  Mean   : 783.0
##  3rd Qu.:1074.8
##  Max.   :1100.0
```
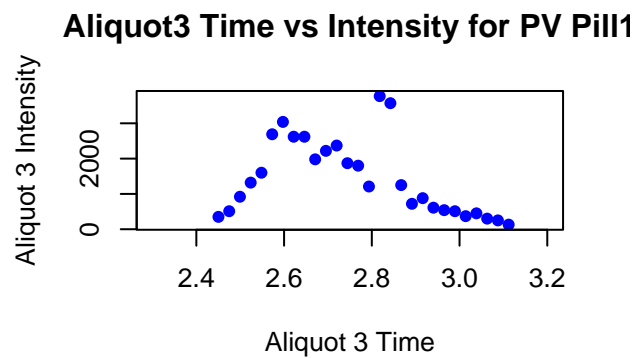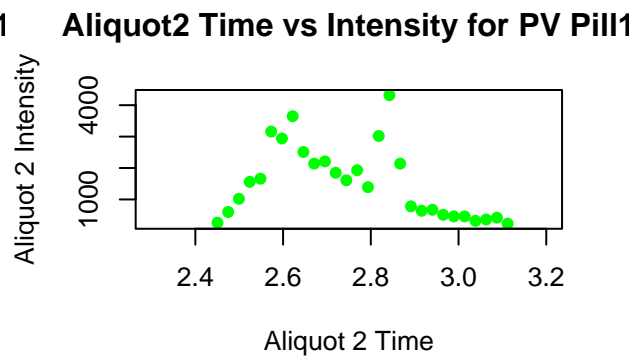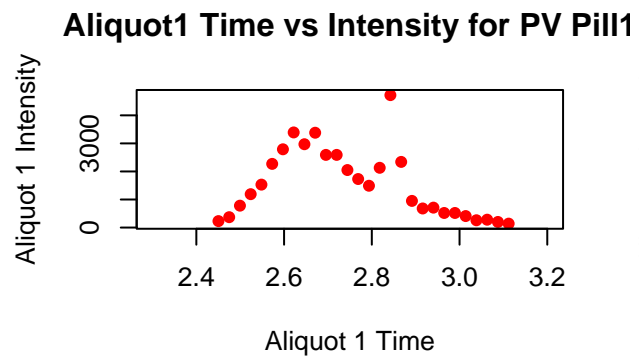
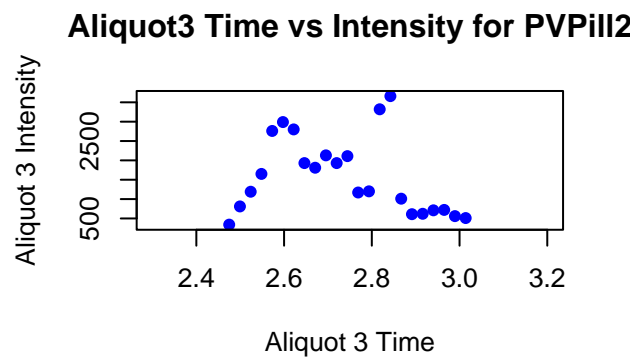**Boxplot of Bayer Pills: Peak 199.10 91.90**

# Scatterplot for Bayer Pills from Peak 199.10 91.90

**Aliquot1 Time vs Intensity for PV Pill1**



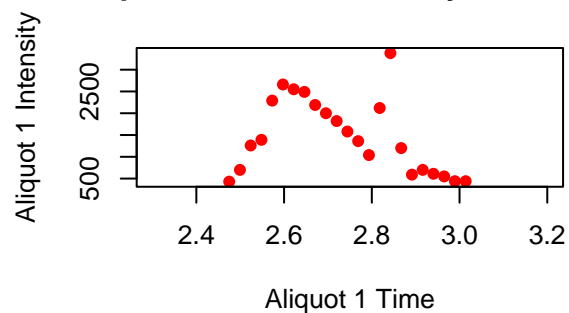**Aliquot2 Time vs Intensity for PV Pill1**



**Aliquot3 Time vs Intensity for PV Pill1**
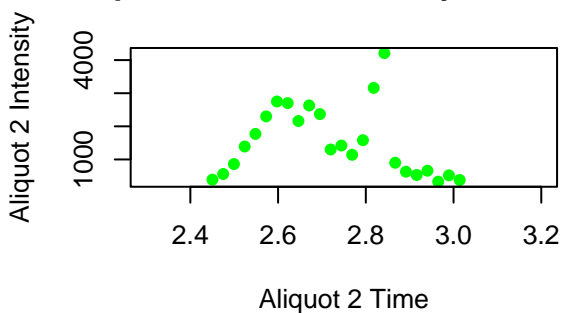
PV 2 Pill from Peak 199.10 137.00

## Aliquot1 Time vs Intensity for PVPill2



## Aliquot2 Time vs Intensity for PVPill2



## Aliquot3 Time vs Intensity for PVPill2
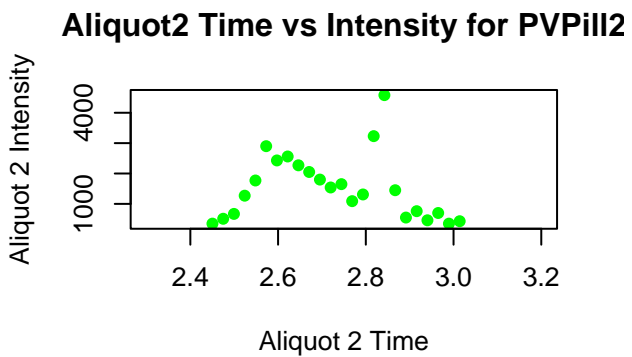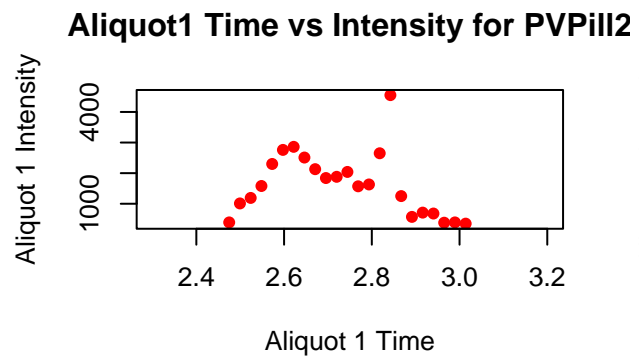
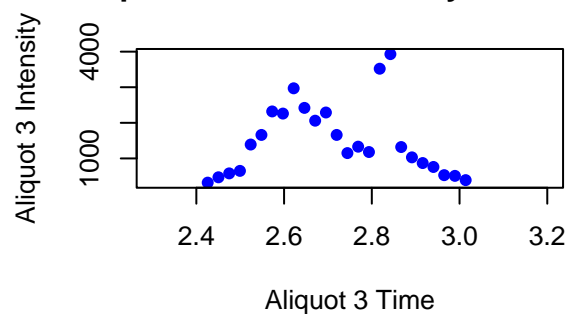PV 3 Pill from Peak 199.10 137.00

**Aliquot1 Time vs Intensity for PVPill3**



**Aliquot2 Time vs Intensity for PVPill3**



**Aliquot3 Time vs Intensity for PVPill3**
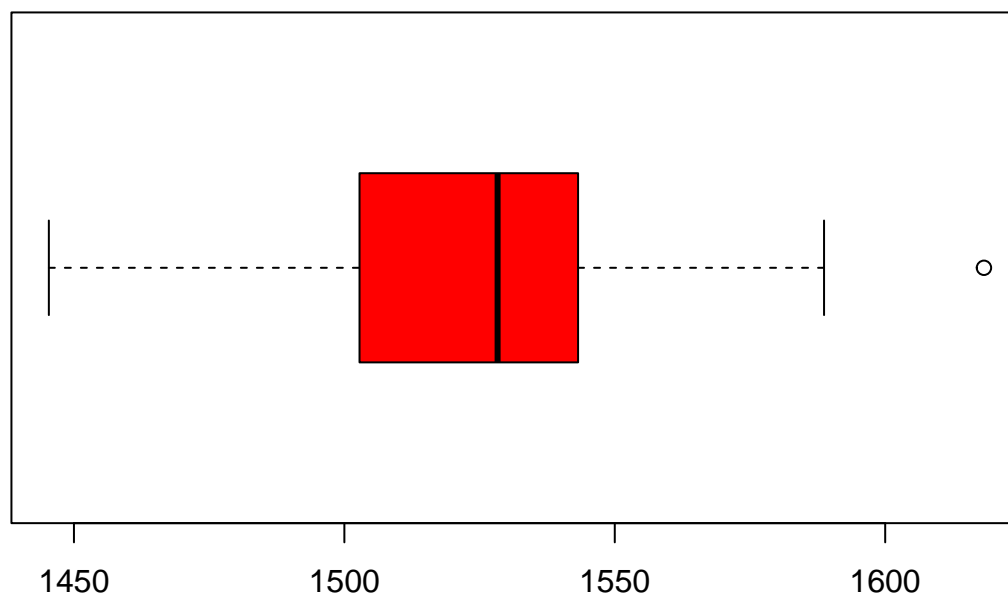
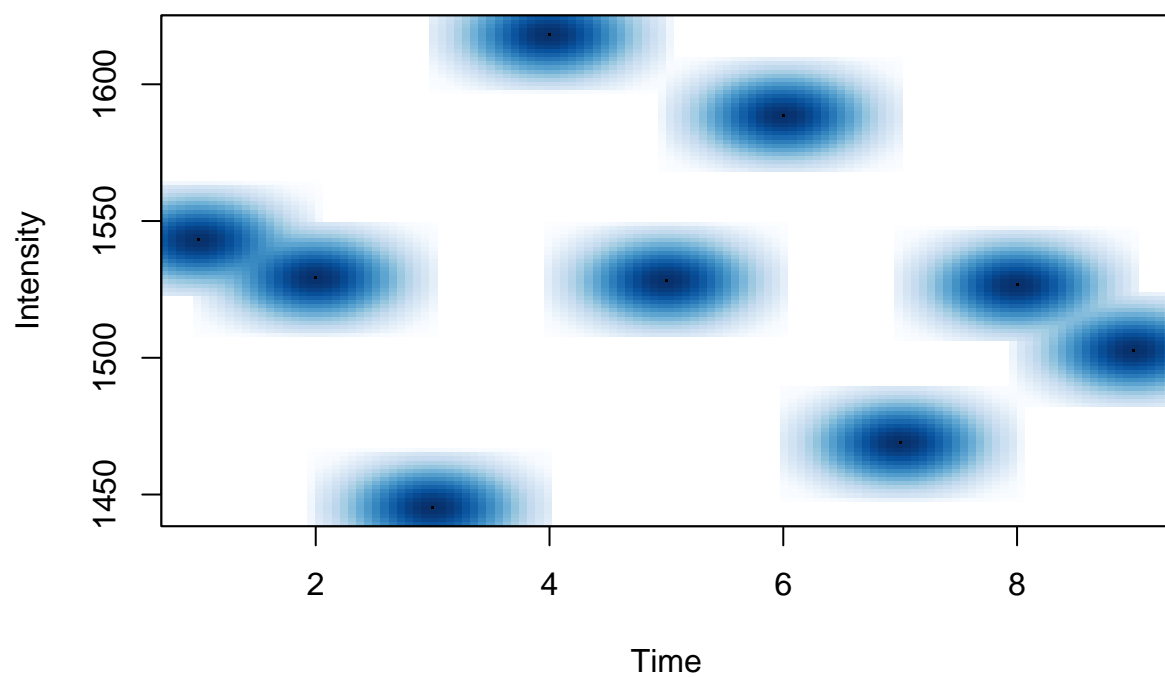

Average P.V Pill Intensities

Data Visualization for PV Pill Peak 199.10 137.00

```
##        PVa
##  Min.   :1445
##  1st Qu.:1503
##  Median :1528
##  Mean   :1528
##  3rd Qu.:1543
##  Max.   :1618
```
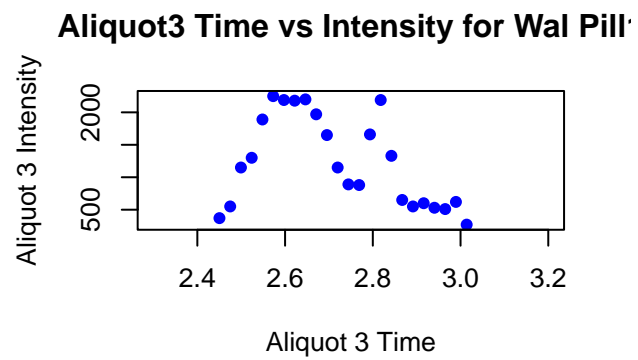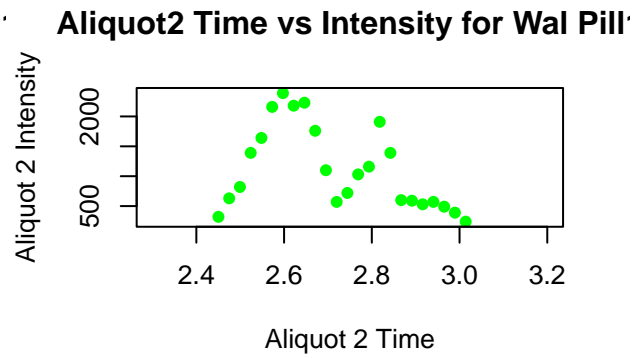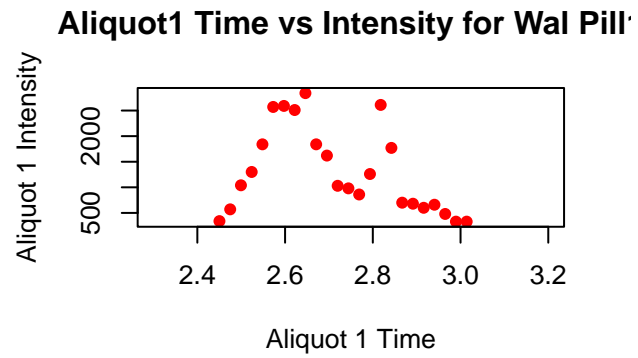
**Boxplot of PV Pills: Peak 199.10 137.00**
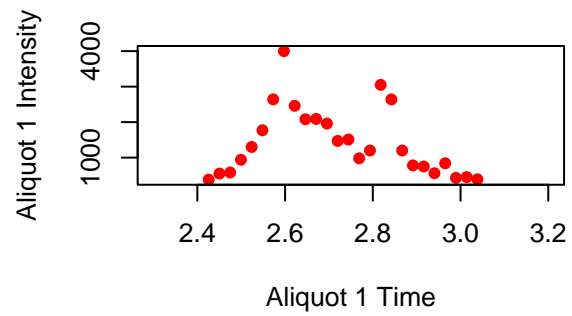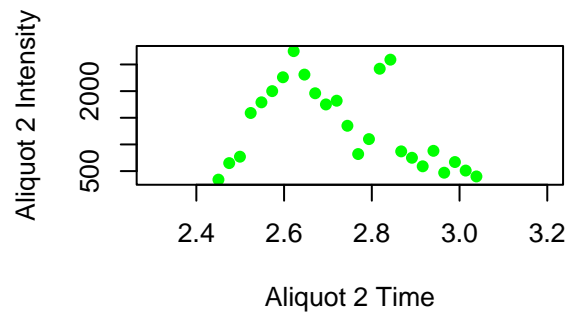
**Scatterplot for PV Pills from Peak 199.10 137.00**

## Aliquot1 Time vs Intensity for Wal Pill1



## Aliquot2 Time vs Intensity for Wal Pill1



## Aliquot3 Time vs Intensity for Wal Pill1

**Aliquot1 Time vs Intensity for Wal Pill2**

**Aliquot2 Time vs Intensity for Wal Pill2**
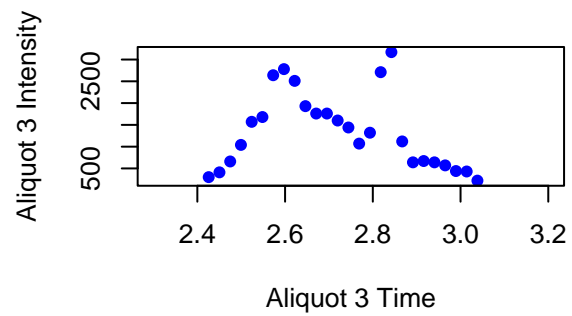
**Aliquot3 Time vs Intensity for Wal Pill2**

### Aliquot1 Time vs Intensity for Wal Pill3



### Aliquot2 Time vs Intensity for Wal Pill3



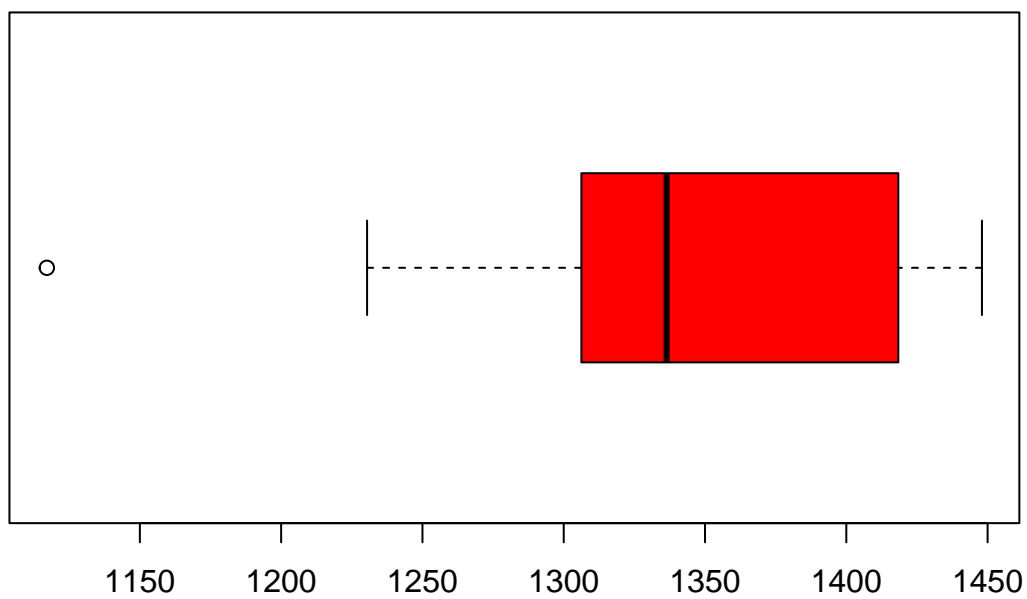### Aliquot3 Time vs Intensity for Wal Pill3
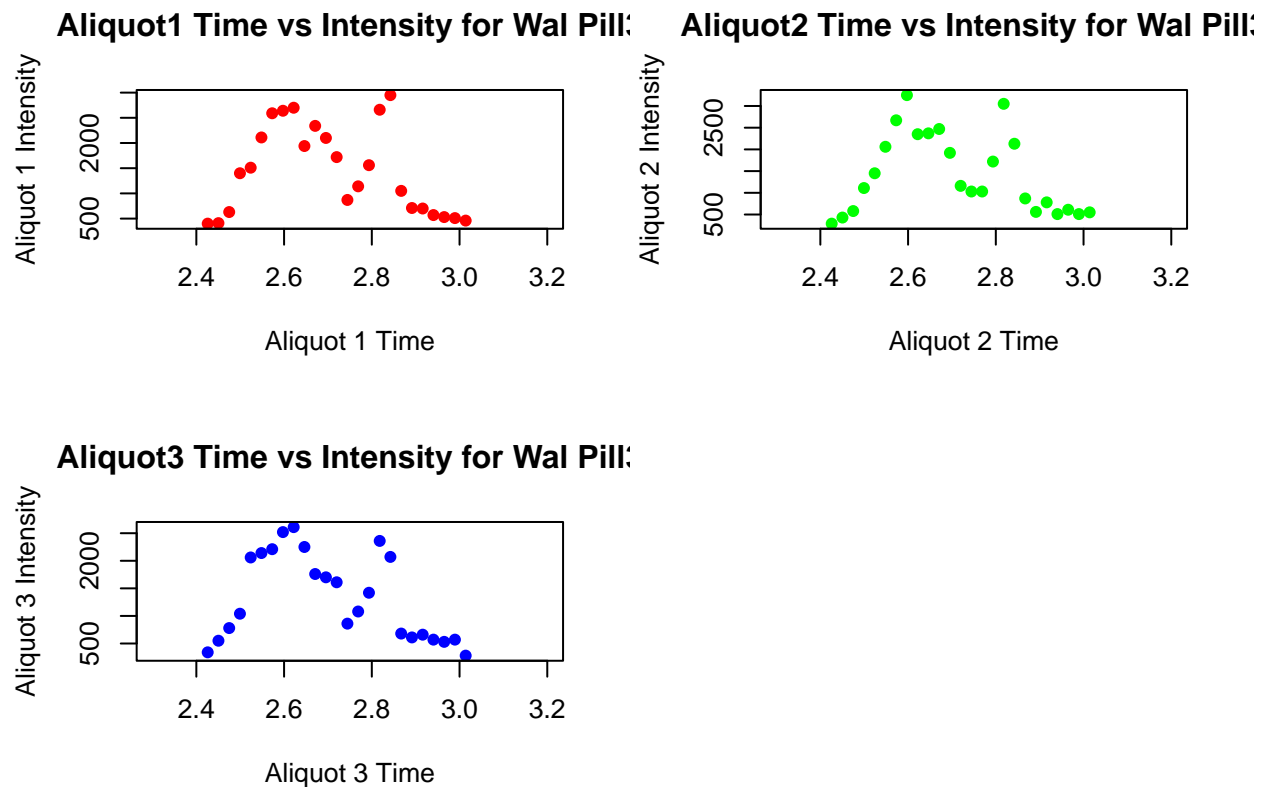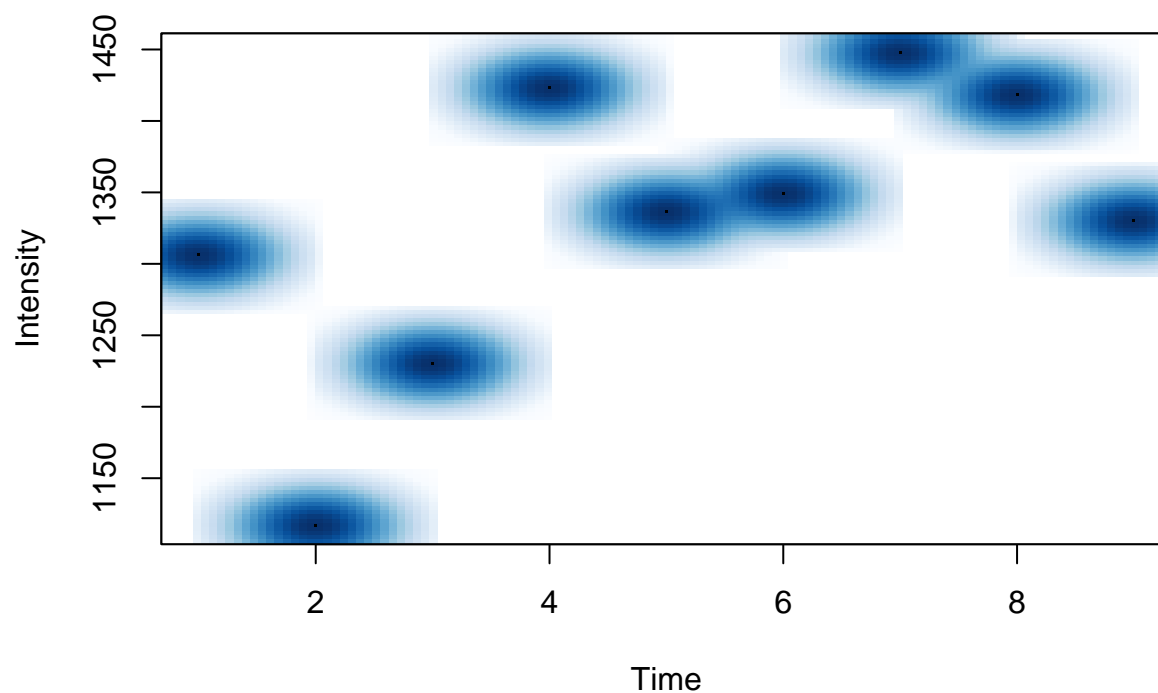


## Average Wal Pill Intensities

## Data Visualization for Wal Pill Peak 199.10 137.00

```
##        WPa
## Min.   :1117
## 1st Qu.:1306
## Median :1336
## Mean   :1329
## 3rd Qu.:1418
## Max.   :1448
```

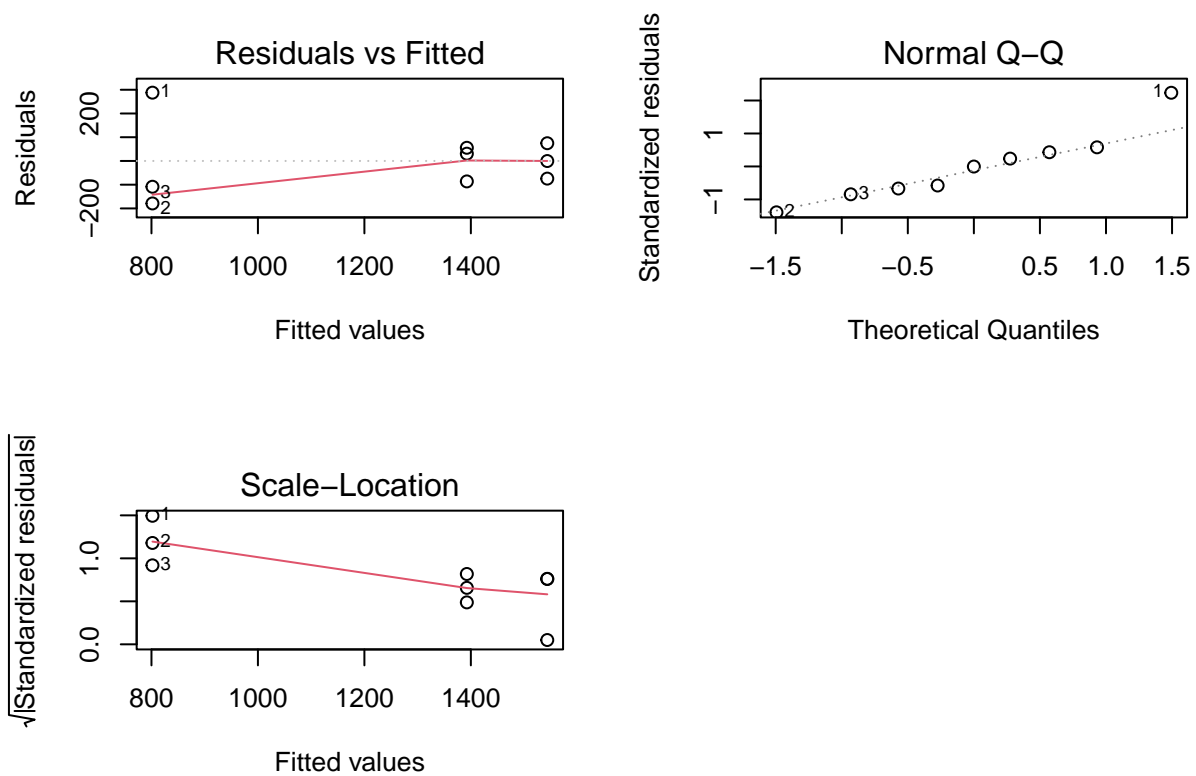**Boxplot of WP Pills: Peak 199.10 137.00**

**Scatterplot for WP Pills from Peak 199.10 137.00**



```
## Anova of Peak 199.10 137.00


##            Df Sum Sq Mean Sq F value  Pr(>F)
## Pills       2 921597  460799   18.52 0.00271 **
## Residuals   6 149253   24876
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```

```
##    Tukey multiple comparisons of means
##      95% family-wise confidence level
##
## Fit: aov(formula = Intensity ~ Pills, data = daa)
##
## $Pills
##          diff       lwr       upr      p adj
## 2-1  741.6372  346.5117 1136.7626 0.0028883
## 3-1  590.5443  195.4188  985.6697 0.0089224
## 3-2 -151.0929 -546.2184  244.0326 0.5092820
```
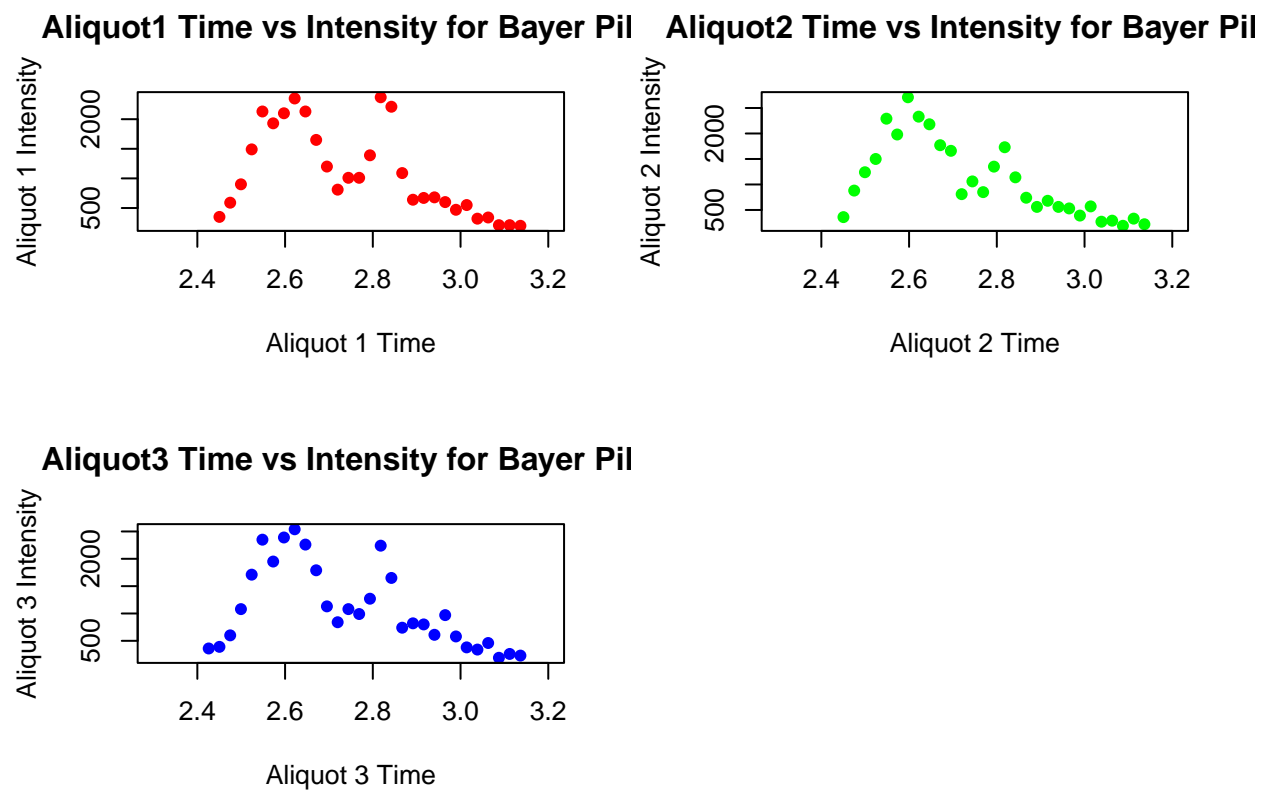
**95% family–wise confidence level**
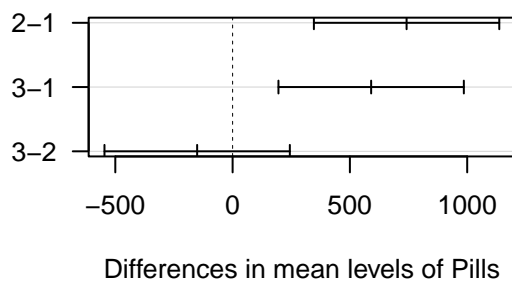


Differences in mean levels of Pills

The p-value of the pills variable is low (p < 0.05), For this peak location, it appears that there are substantial differences between the tablets. According to the findings of the post-hoc test,We can see that pill groups 2 and 1 have statistically significant differences (p<0.05). Also We can see that pill groups 3 and 1 have statistically significant differences (p<0.05).

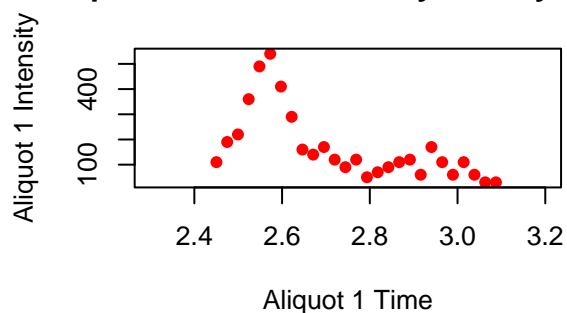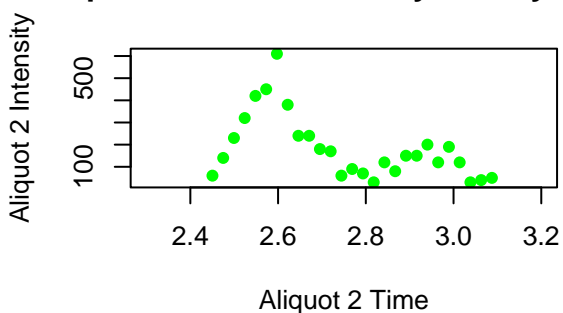Loading Data set for Peak 240.00 92.900
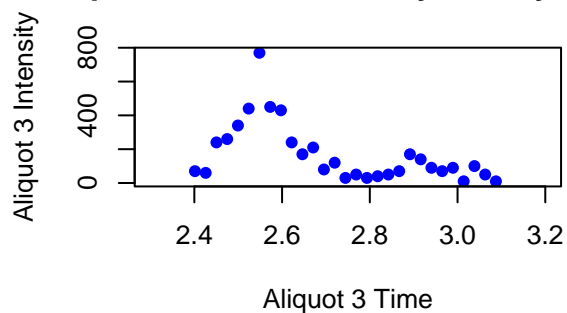
Bayer Pill 1 from Peak 240.00 92.900
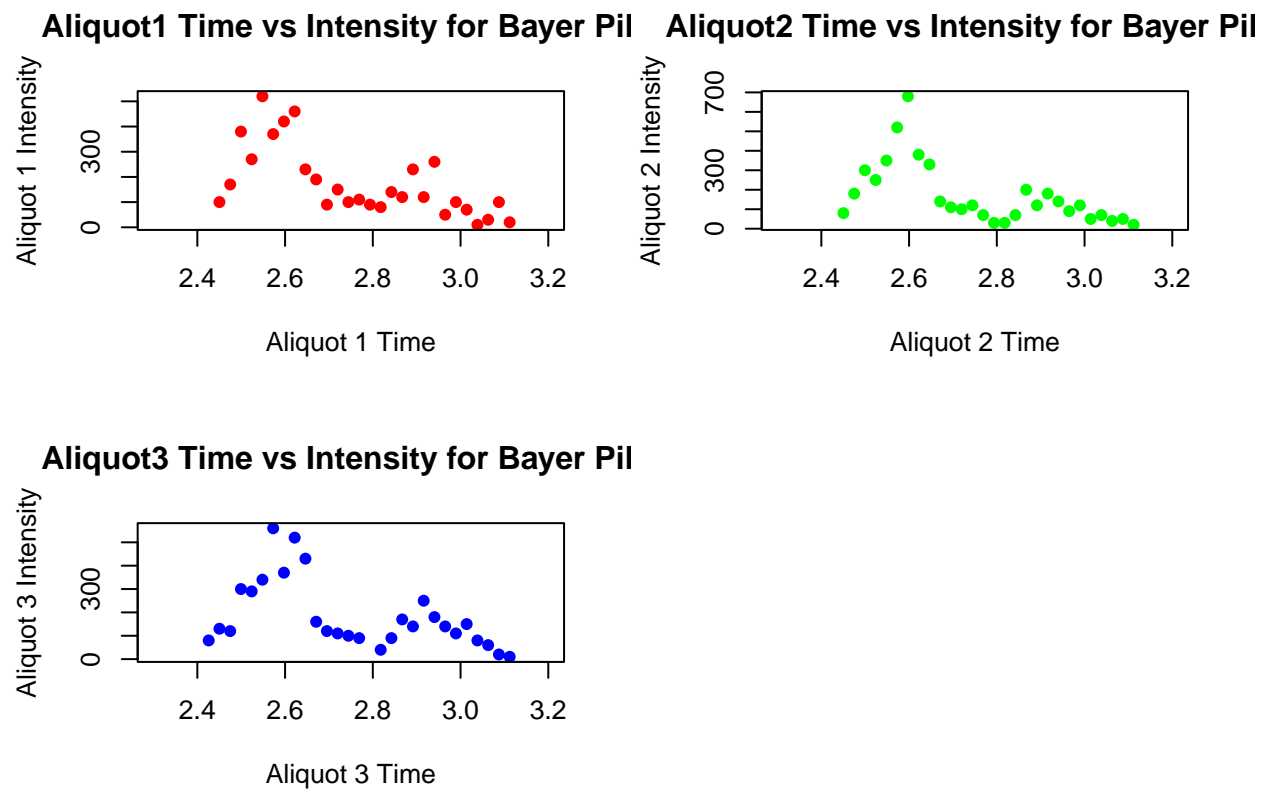
**Aliquot1 Time vs Intensity for Bayer Pil**

**Aliquot2 Time vs Intensity for Bayer Pil**

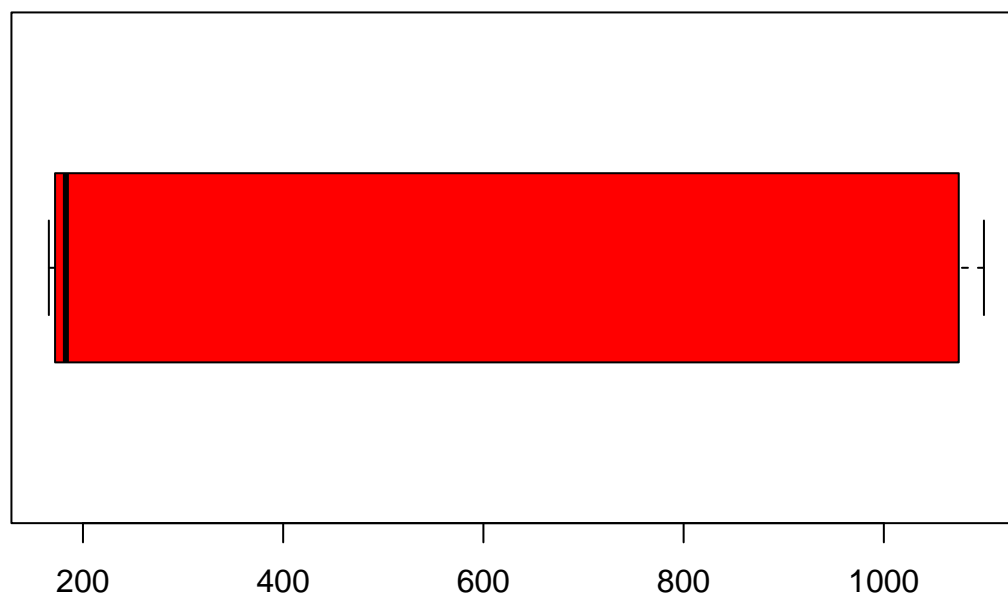**Aliquot3 Time vs Intensity for Bayer Pil**

Bayer Pill 2 from Peak 240.00 92.900

**Aliquot1 Time vs Intensity for Bayer Pil**   **Aliquot2 Time vs Intensity for Bayer Pil**



**Aliquot3 Time vs Intensity for Bayer Pil**



### Bayer Pill 3 from Peak 240.00 92.900

## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



## Aliquot3 Time vs Intensity for Bayer Pil



Average Bayer Pill Intensities
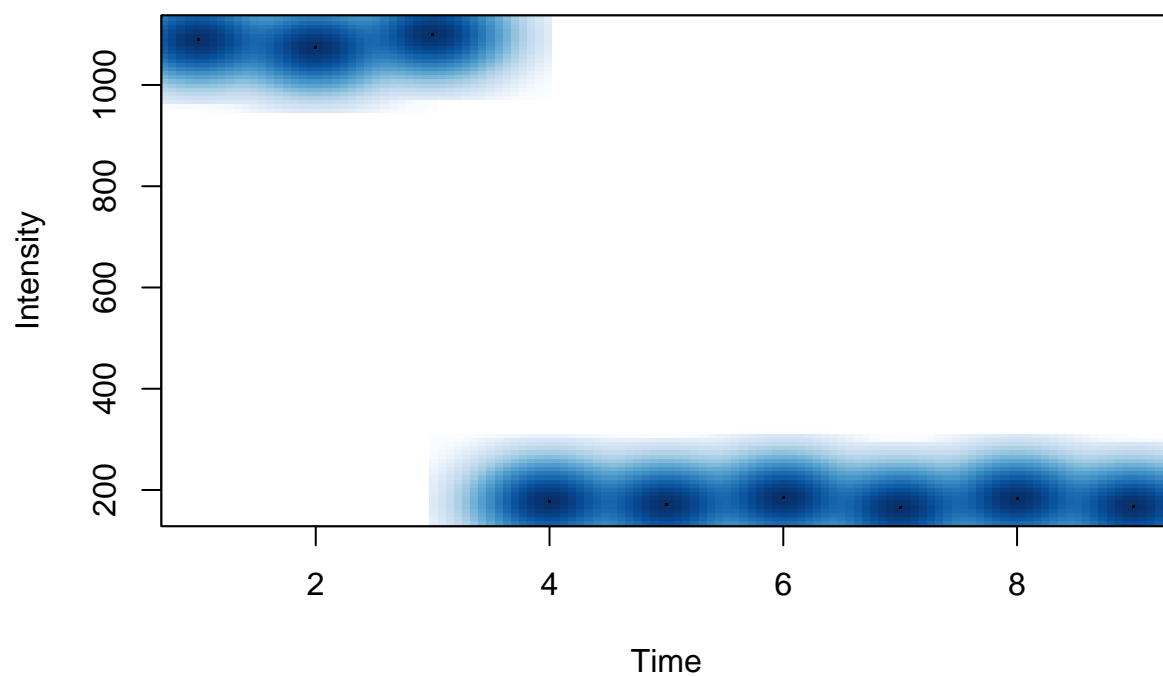
Data Visualization for Bayer Pill Peak 240.00 92.900

```
##        BP.240
##  Min.   : 165.9
##  1st Qu.: 172.1
##  Median : 183.0
##  Mean   : 479.5
##  3rd Qu.:1074.8
##  Max.   :1100.0
```
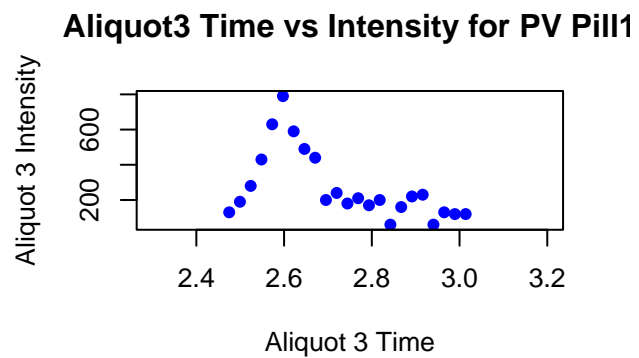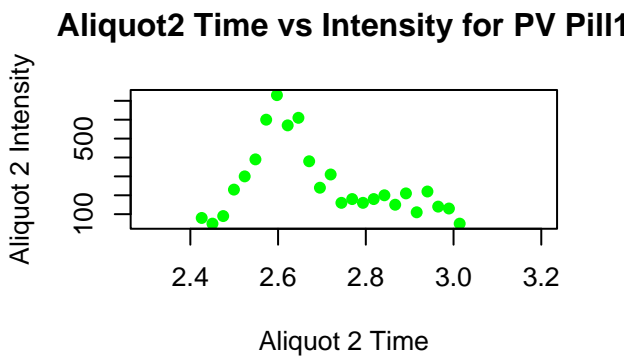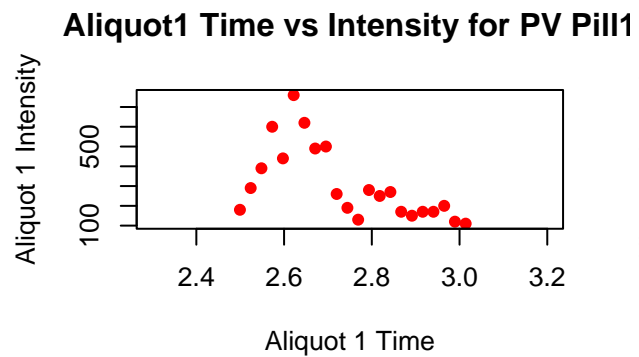
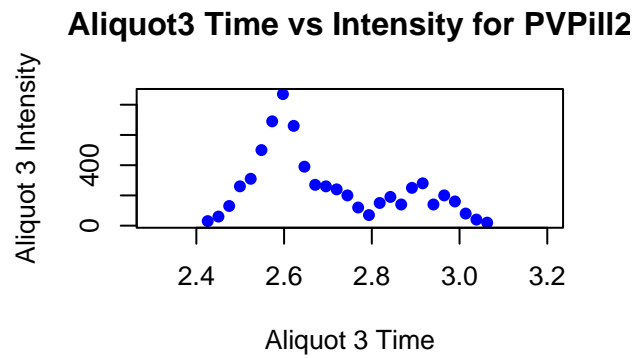**Boxplot of Bayer Pills: Peak 240.00 92.900**

**Scatterplot for Bayer Pills from Peak 240.00 92.900**

**Aliquot1 Time vs Intensity for PV Pill1**

**Aliquot2 Time vs Intensity for PV Pill1**

**Aliquot3 Time vs Intensity for PV Pill1**

## Aliquot1 Time vs Intensity for PVPill2



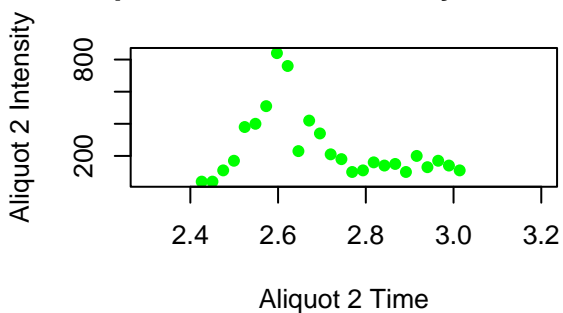## Aliquot2 Time vs Intensity for PVPill2
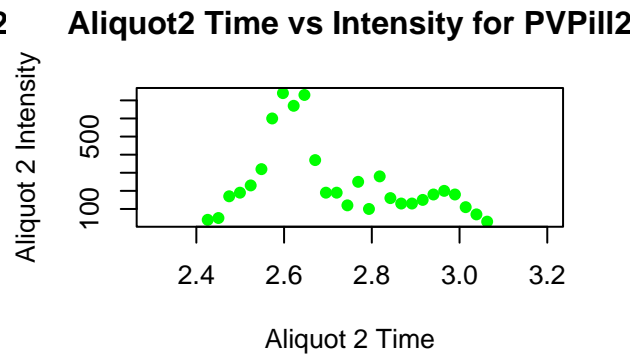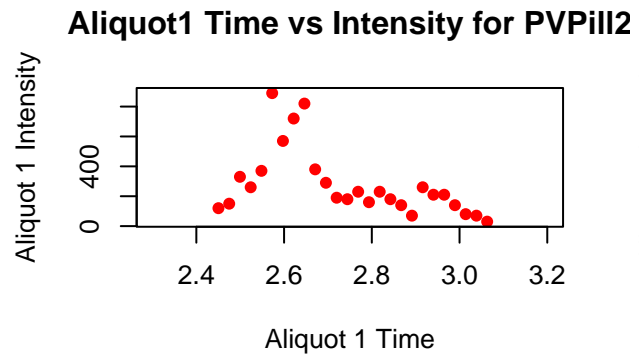


## Aliquot3 Time vs Intensity for PVPill2
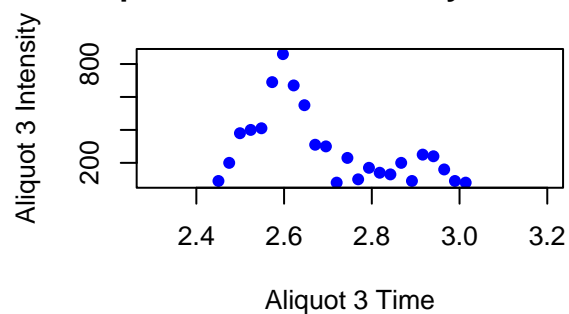
## Aliquot1 Time vs Intensity for PVPill3
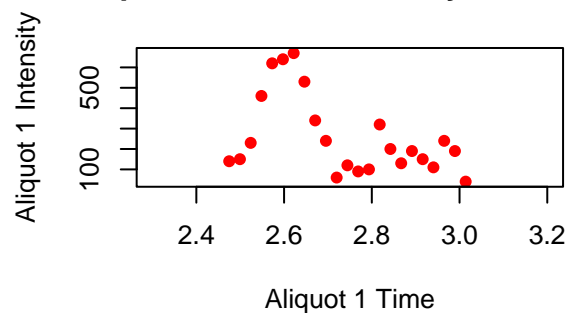


## Aliquot2 Time vs Intensity for PVPill3



## Aliquot3 Time vs Intensity for PVPill3
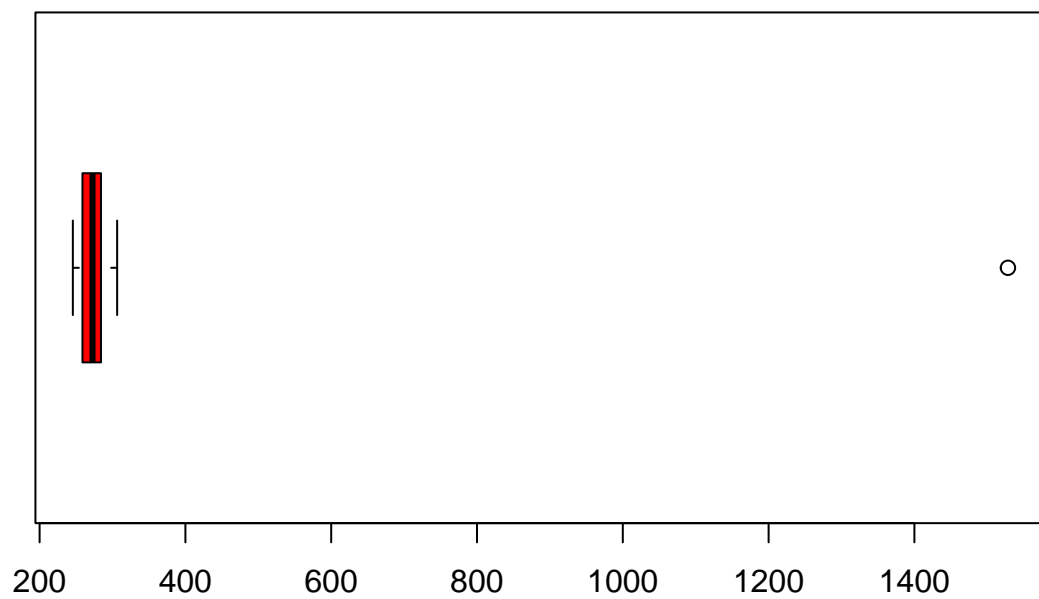


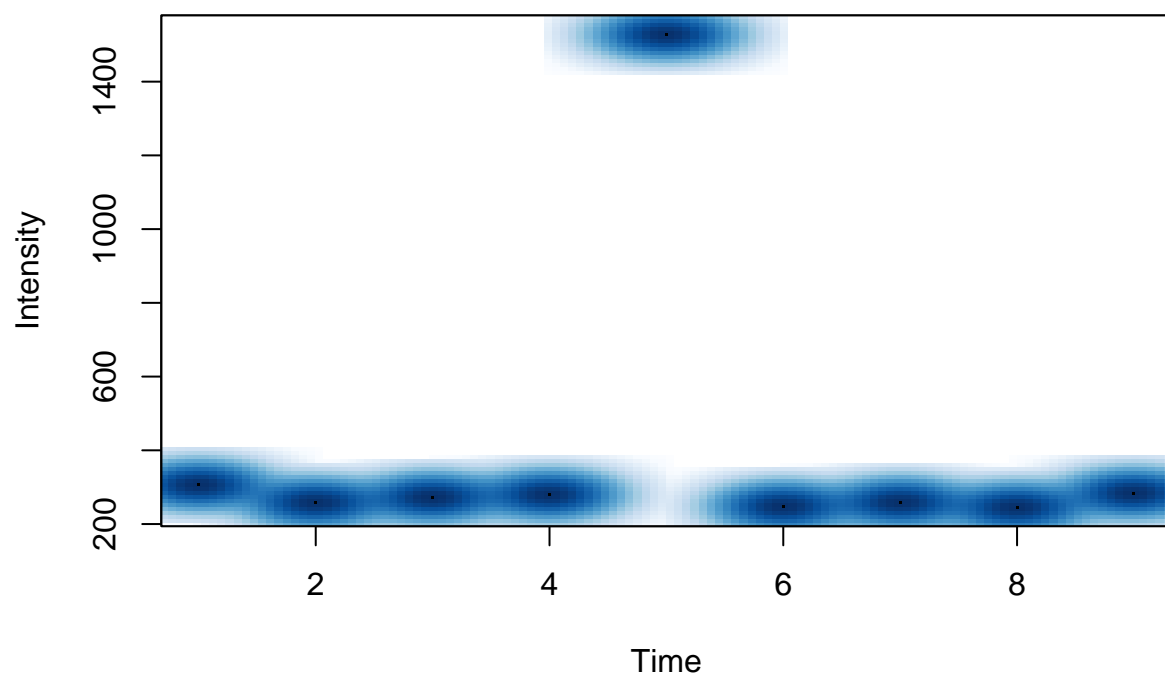## Average P.V Pill Intensities

## Data Visualization for PV Pill Peak 240.00 92.900

```
##       PV.240
## Min.   : 245.6
## 1st Qu.: 258.8
## Median : 272.6
## Mean   : 409.3
## 3rd Qu.: 284.2
## Max.   :1528.3
```
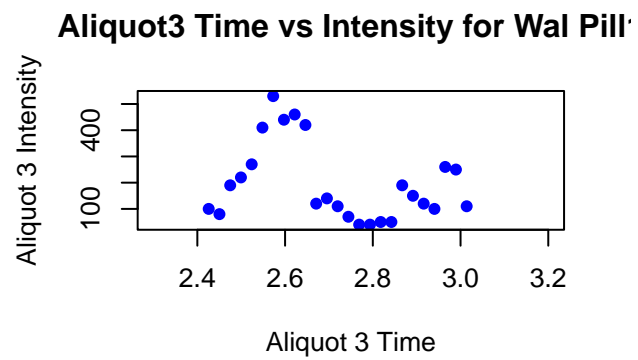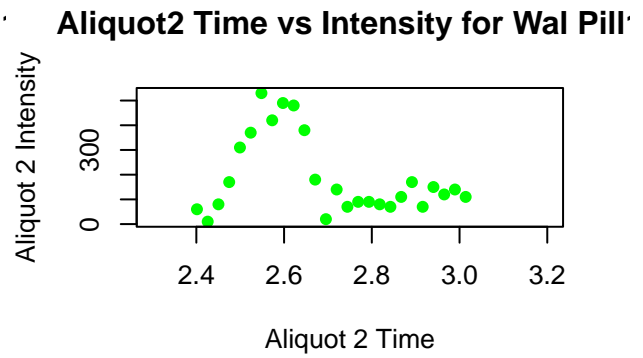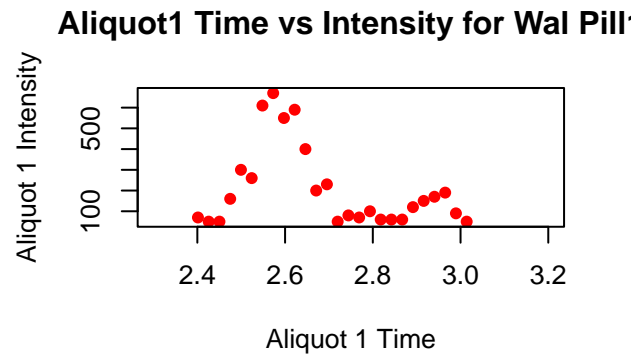
**Boxplot of PV Pills: Peak 240.00 92.900**
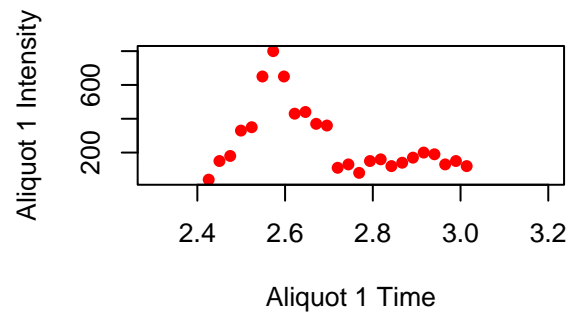
# Scatterplot for PV Pills from Peak 240.00 92.900

### Aliquot1 Time vs Intensity for Wal Pill



### Aliquot2 Time vs Intensity for Wal Pill



### Aliquot3 Time vs Intensity for Wal Pill

**Aliquot1 Time vs Intensity for Wal Pill2**



**Aliquot2 Time vs Intensity for Wal Pill2**



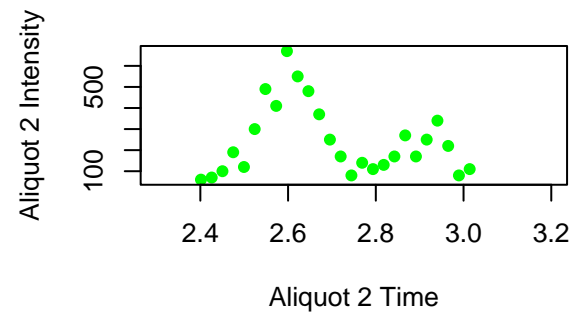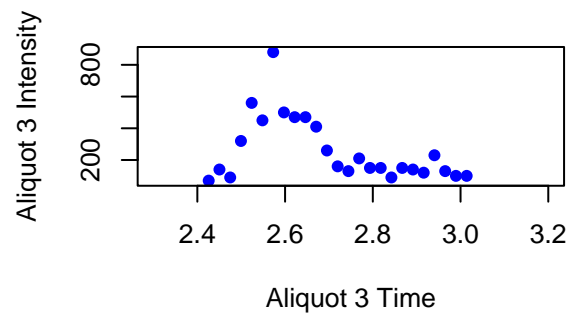**Aliquot3 Time vs Intensity for Wal Pill2**

**Wal Pill 3 from Peak 240.00 92.900**

### Aliquot1 Time vs Intensity for Wal Pill3

### Aliquot2 Time vs Intensity for Wal Pill3

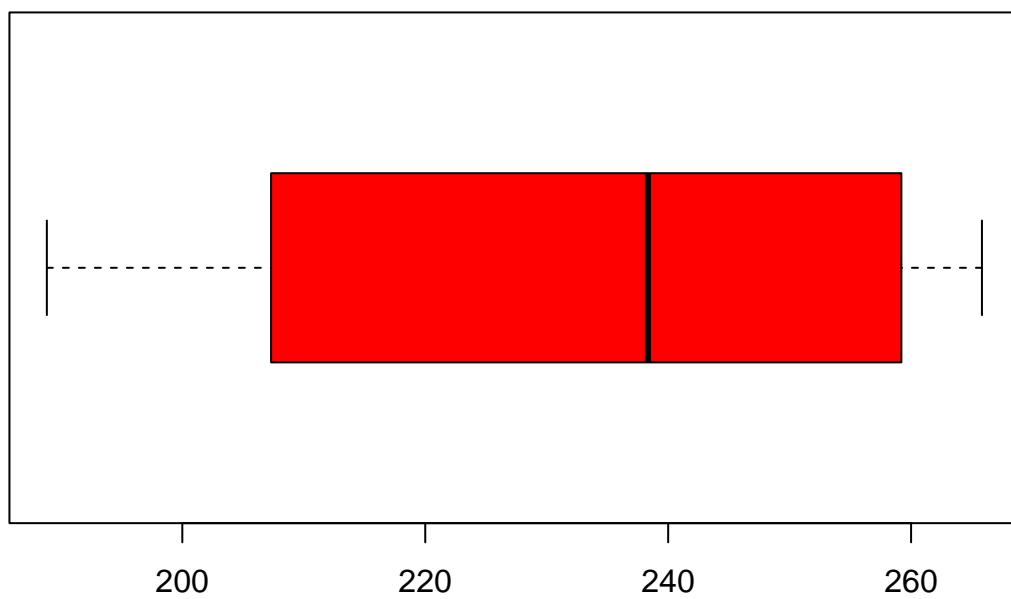### Aliquot3 Time vs Intensity for Wal Pill3
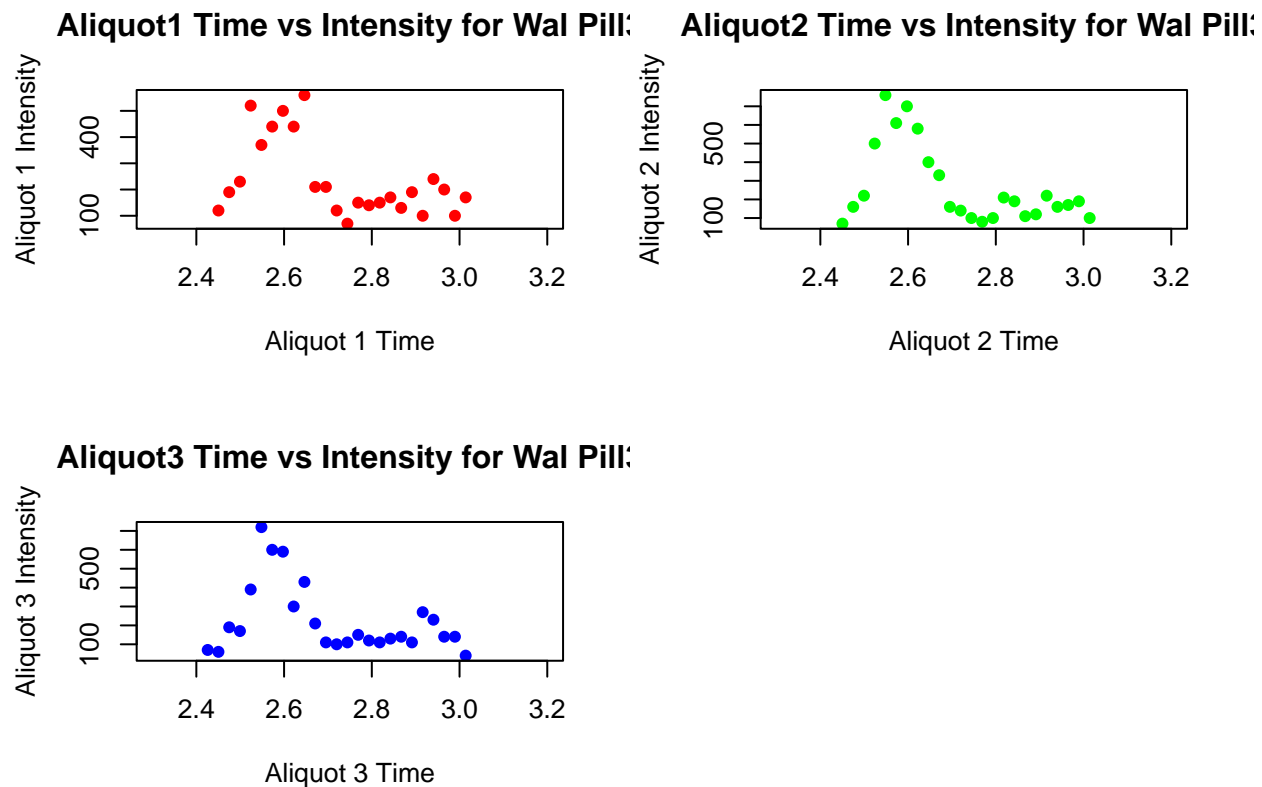
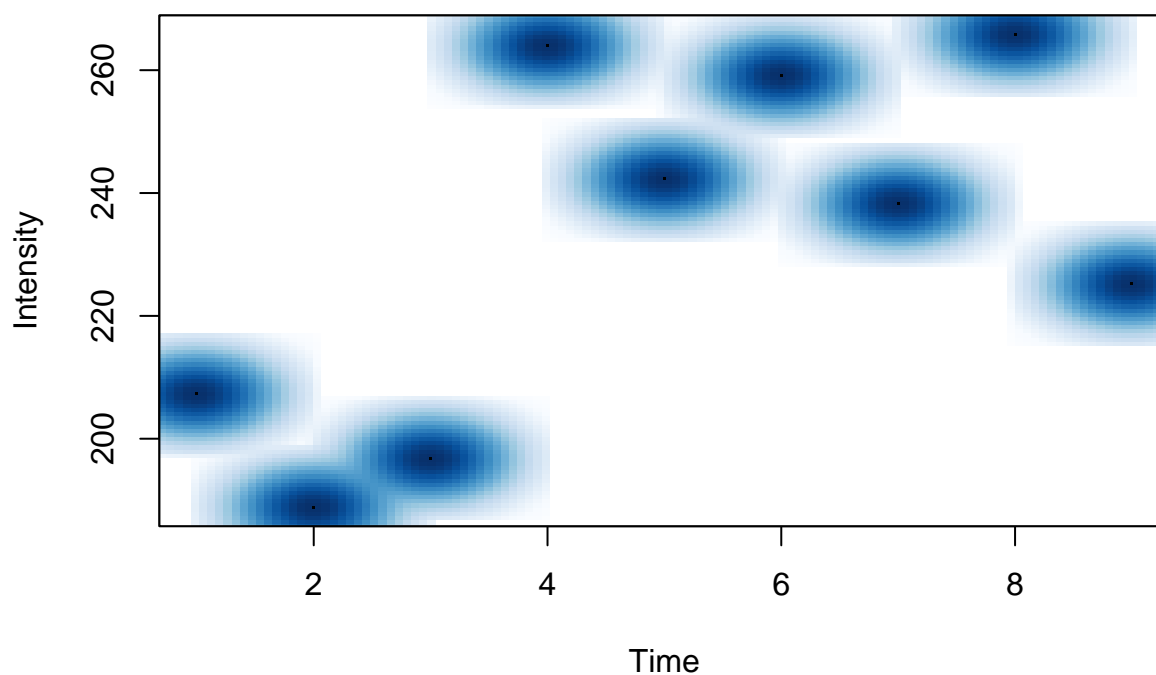## Average Wal Pill Intensities

## Data Visualization for Wal Pill Peak 240.00 92.900

```
##       WP.240
## Min.   :188.8
## 1st Qu.:207.3
## Median :238.3
## Mean   :232.0
## 3rd Qu.:259.2
## Max.   :265.8
```

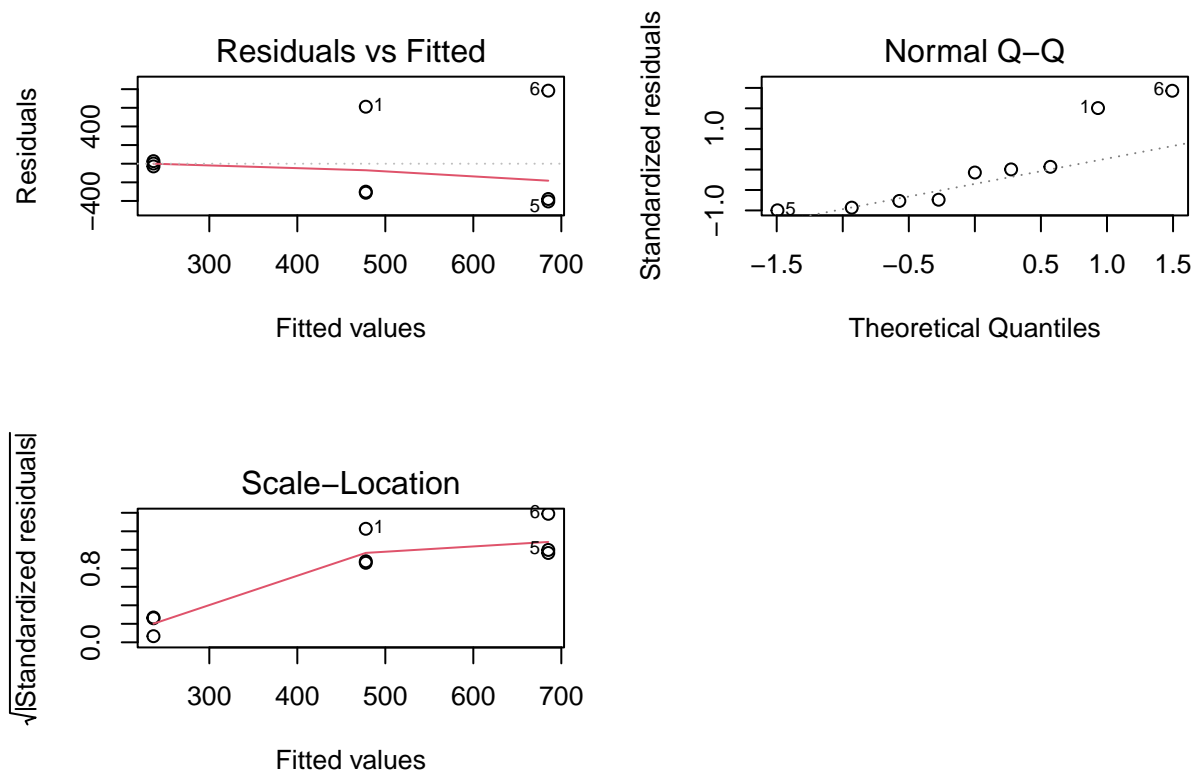# Boxplot of WP Pills: Peak 240.00 92.900

## Scatterplot for WP Pills from Peak 240.00 92.900



## Anova of Peak 240.00 92.900

```
##            Df  Sum Sq Mean Sq F value Pr(>F)
## Pills       2  302462  151231   0.611  0.574
## Residuals   6 1485461  247577

## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```

## Residuals vs Fitted



## Normal Q–Q



## Scale–Location



```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Intensity ~ Pills, data = da.240)
##
## $Pills
##          diff        lwr       upr      p adj
## 2-1  207.3519 -1039.180 1453.8842 0.8691926
## 3-1 -241.2657 -1487.798 1005.2665 0.8284255
## 3-2 -448.6177 -1695.150  797.9146 0.5460288
```
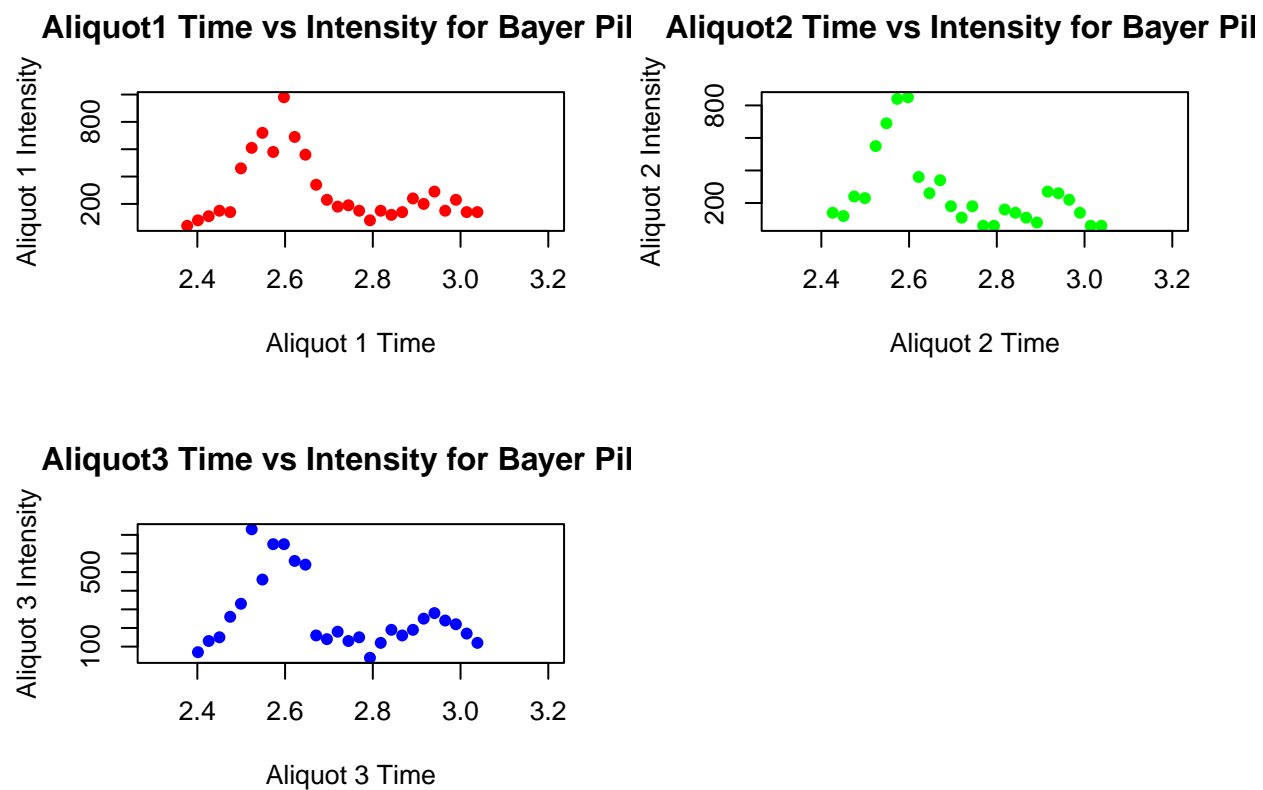
## 95% family–wise confidence level
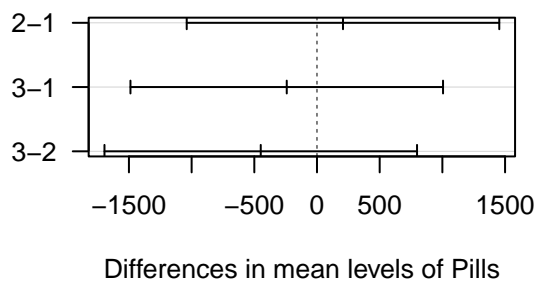


Differences in mean levels of Pills

The p-value of the pills variable is high (p >0.05), For this peak location, it appears that there are no substantial differences between the tablets. According to the findings of the post-hoc test, there are no statistically significant differences (p > 0.05) between pill groups.

Loading Data set for Peak 240.00 137.100
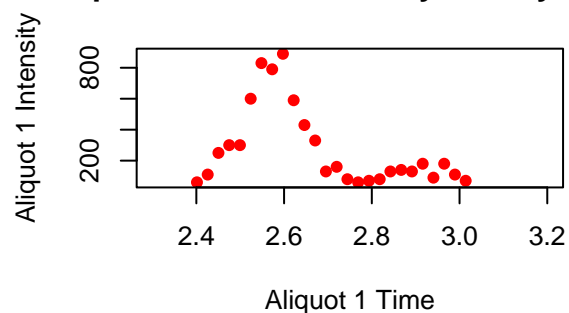
Bayer Pill 1 from Peak 240.00 137.100
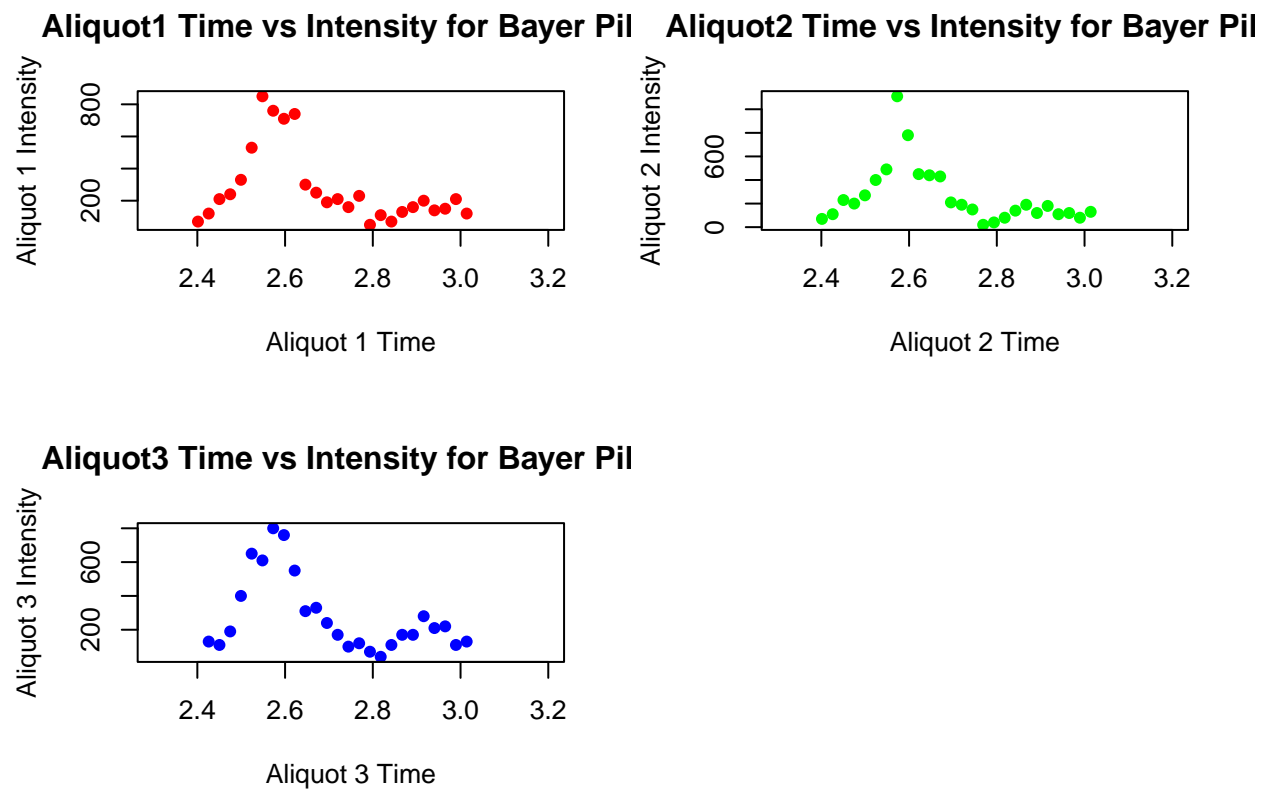
**Aliquot1 Time vs Intensity for Bayer Pil**



**Aliquot2 Time vs Intensity for Bayer Pil**
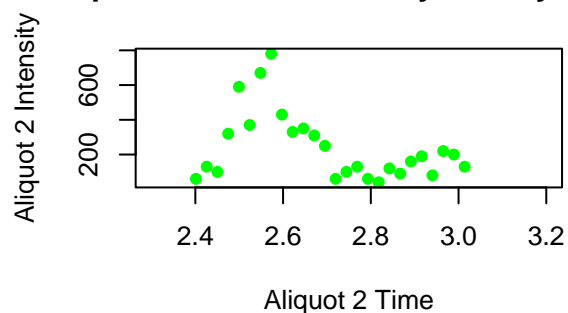


**Aliquot3 Time vs Intensity for Bayer Pil**

Bayer Pill 2 from Peak 240.00 137.100

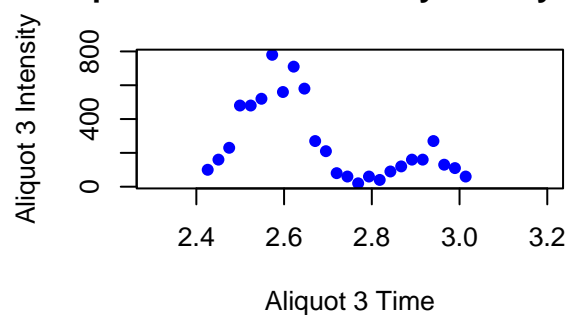## Aliquot1 Time vs Intensity for Bayer Pil



## Aliquot2 Time vs Intensity for Bayer Pil



## Aliquot3 Time vs Intensity for Bayer Pil



### Bayer Pill 3 from Peak 240.00 137.100

## Aliquot1 Time vs Intensity for Bayer Pil



Aliquot 1 Time

## Aliquot2 Time vs Intensity for Bayer Pil



Aliquot 2 Time

## Aliquot3 Time vs Intensity for Bayer Pil
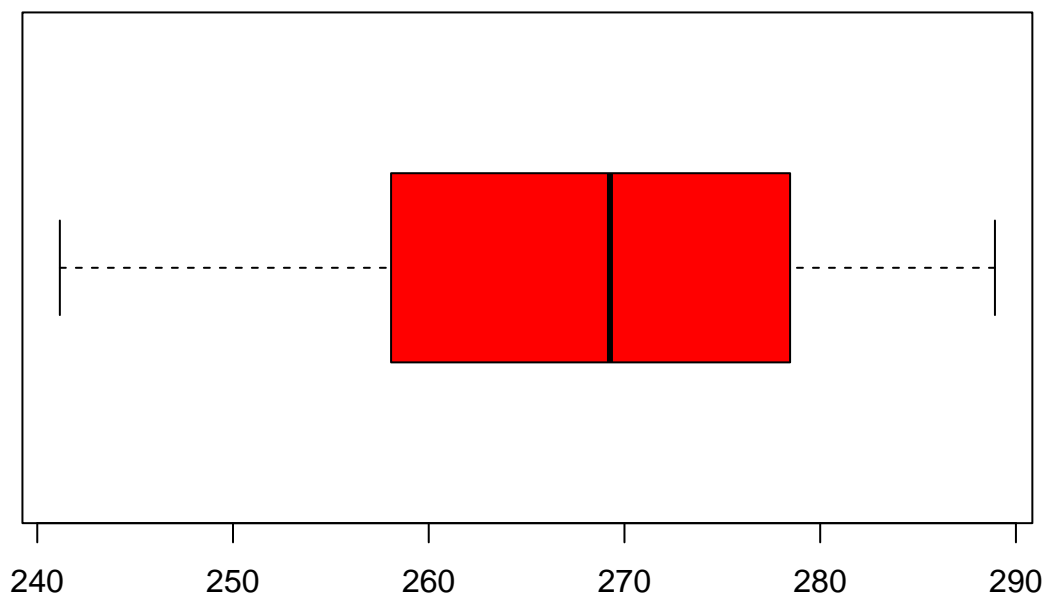


Aliquot 3 Time

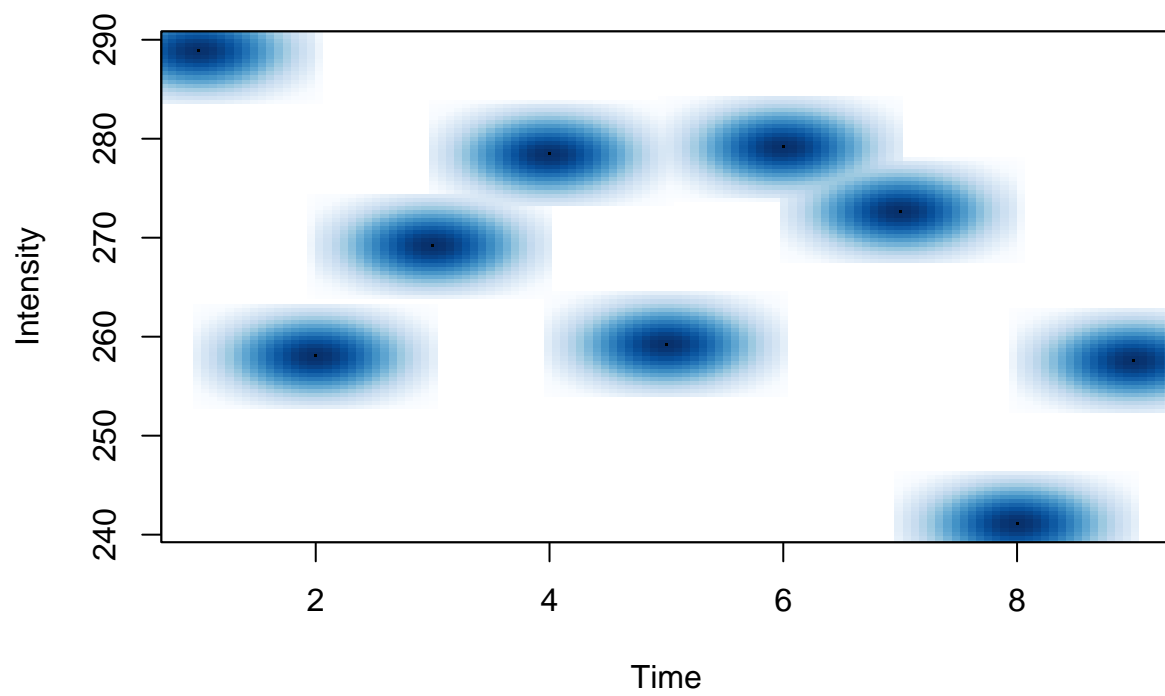Average Bayer Pill Intensities

Data Visualization for Bayer Pill Peak 240.00 137.100

```
##        BP.100
##  Min.   :241.2
##  1st Qu.:258.1
##  Median :269.3
##  Mean   :267.2
##  3rd Qu.:278.5
##  Max.   :288.9
```
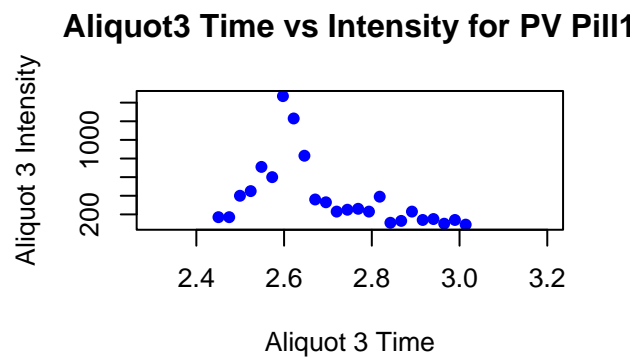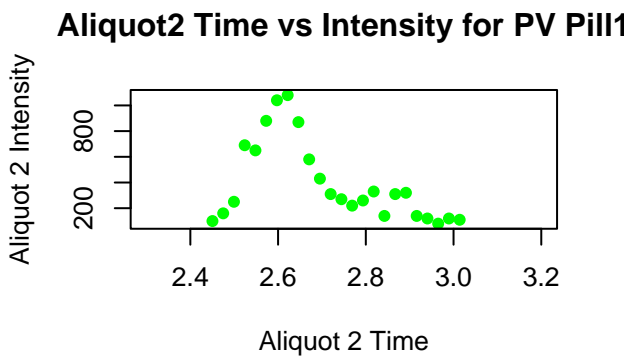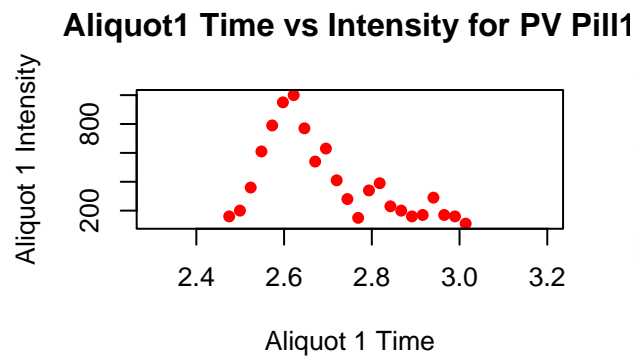
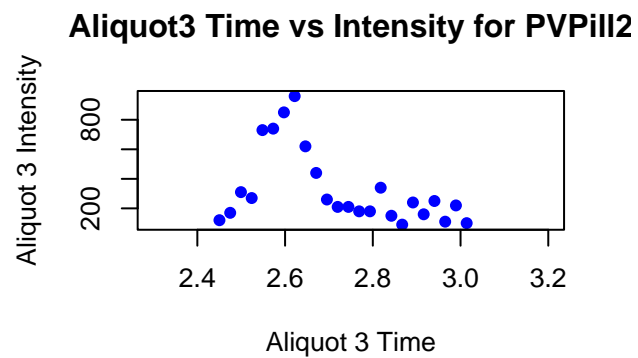**Boxplot of Bayer Pills: Peak 240.00 137.100**

# Scatterplot for Bayer Pills from Peak 240.00 137.100

### Aliquot1 Time vs Intensity for PV Pill1



### Aliquot2 Time vs Intensity for PV Pill1



### Aliquot3 Time vs Intensity for PV Pill1

**Aliquot1 Time vs Intensity for PVPill2**



**Aliquot2 Time vs Intensity for PVPill2**
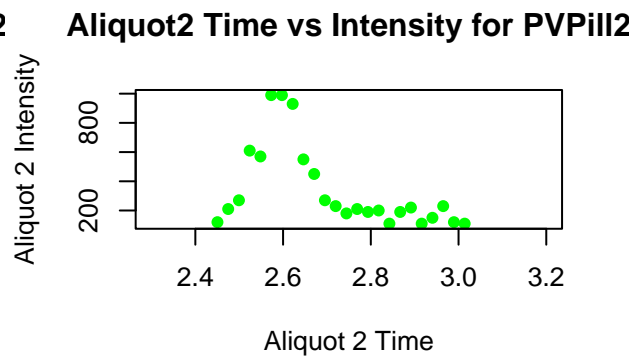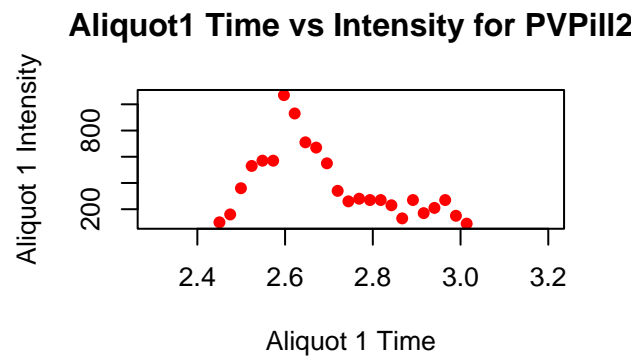


**Aliquot3 Time vs Intensity for PVPill2**
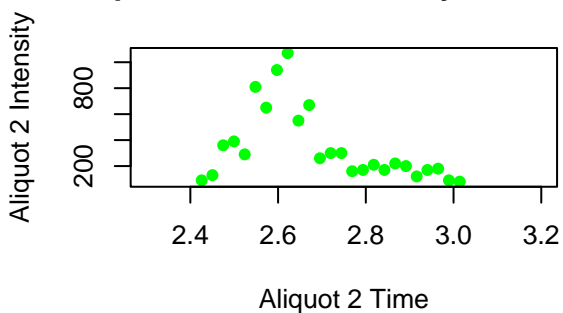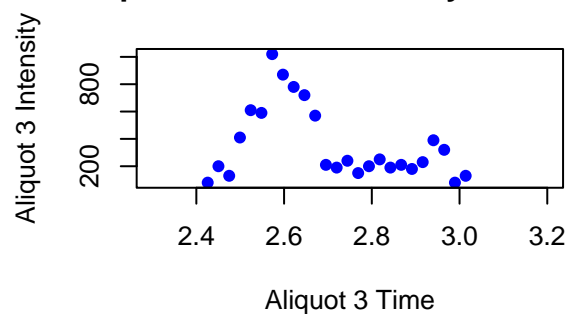
## Aliquot1 Time vs Intensity for PVPill3
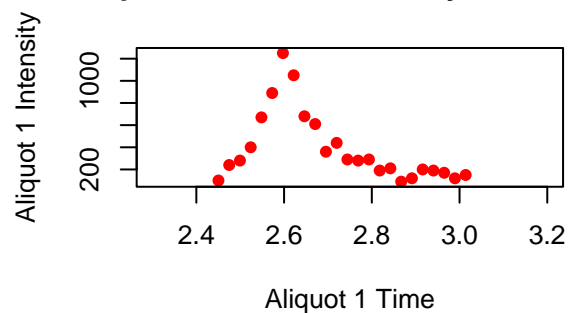
## Aliquot2 Time vs Intensity for PVPill3

## Aliquot3 Time vs Intensity for PVPill3
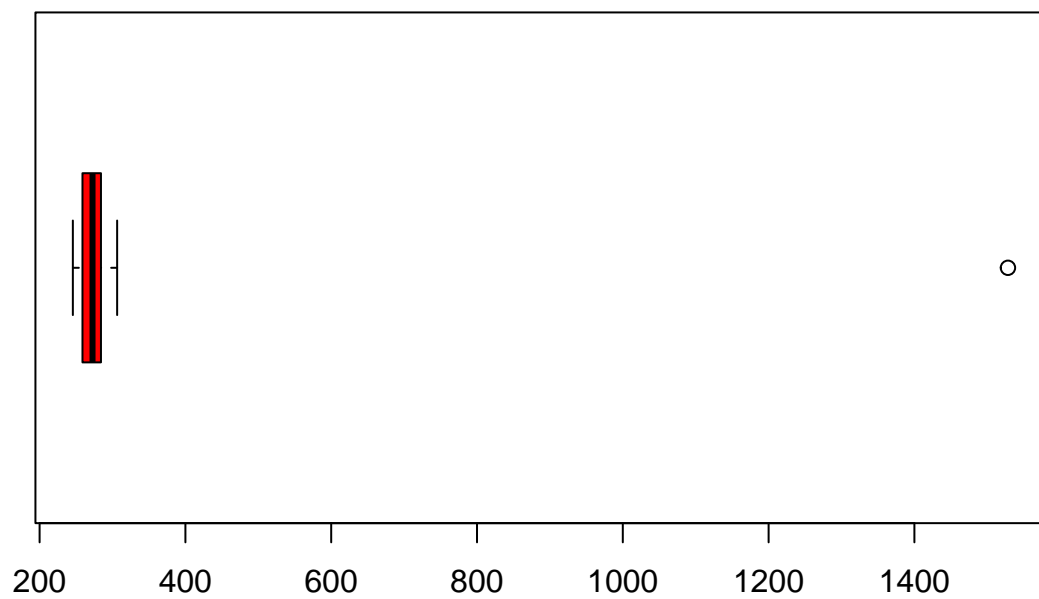
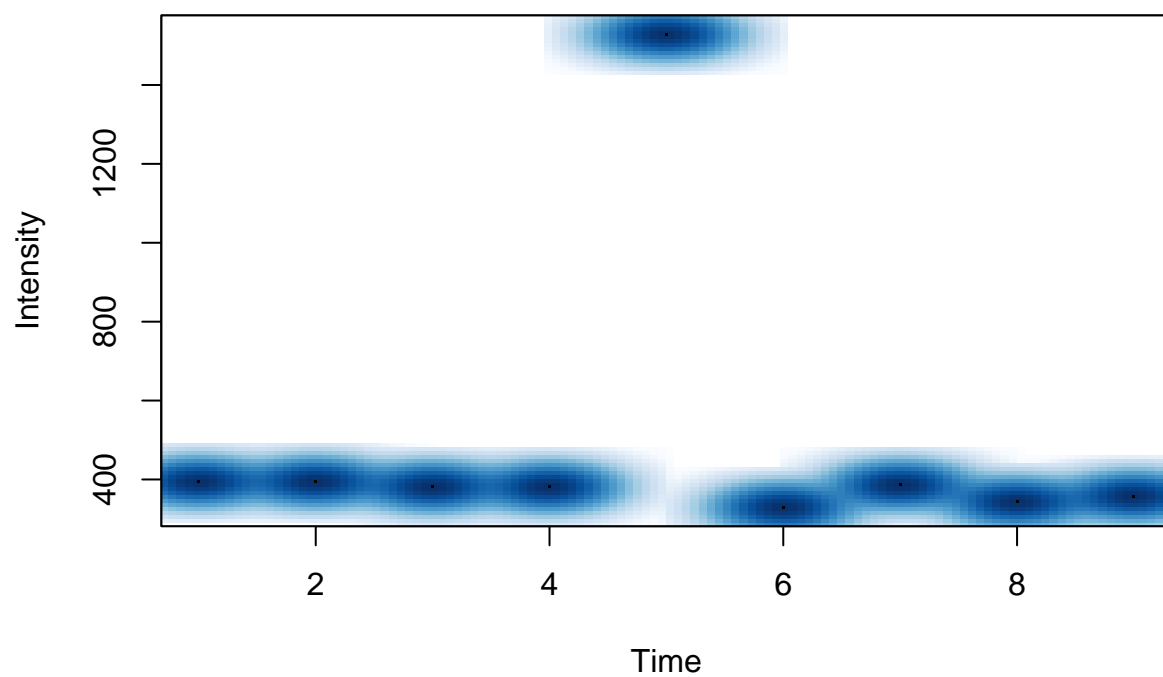Average P.V Pill Intensities

Data Visualization for PV Pill Peak 240.00 137.100

```
##       PV.100
##  Min.   : 329.6
##  1st Qu.: 358.0
##  Median : 382.1
##  Mean   : 499.7
##  3rd Qu.: 394.2
##  Max.   :1528.3
```
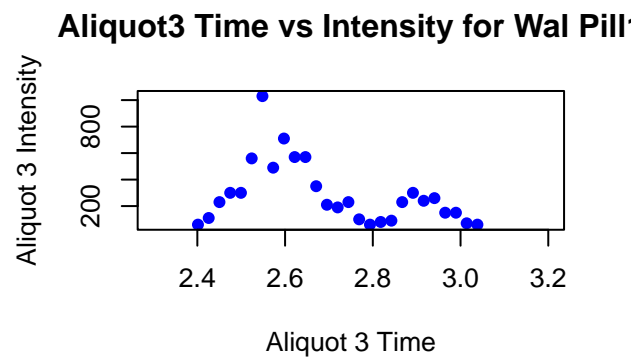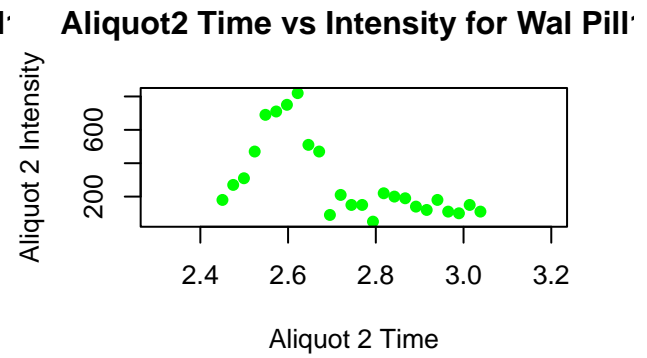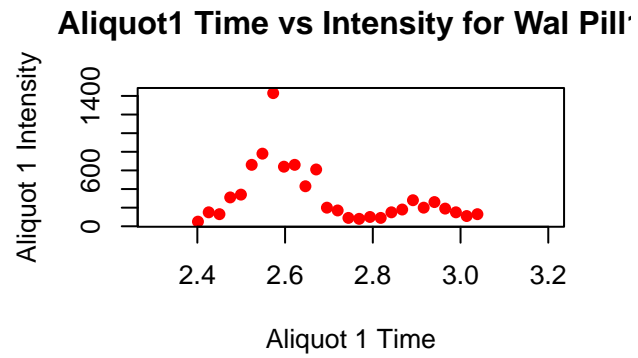
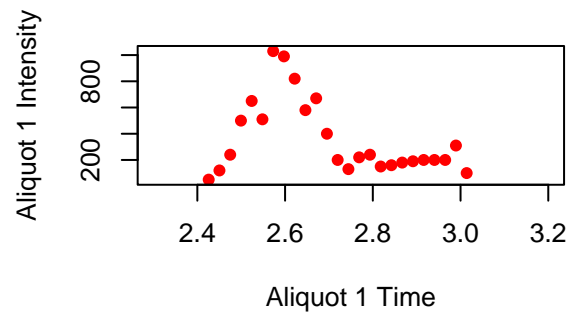**Boxplot of PV Pills: Peak 240.00 137.100**

**Scatterplot for PV Pills from Peak 240.00 137.100**
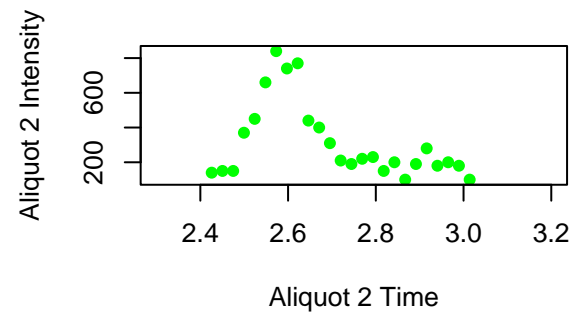
Wal Pill 1 from Peak 240.00 137.100

**Aliquot1 Time vs Intensity for Wal Pill**



**Aliquot2 Time vs Intensity for Wal Pill**



**Aliquot3 Time vs Intensity for Wal Pill**

## Aliquot1 Time vs Intensity for Wal Pill2



## Aliquot2 Time vs Intensity for Wal Pill2
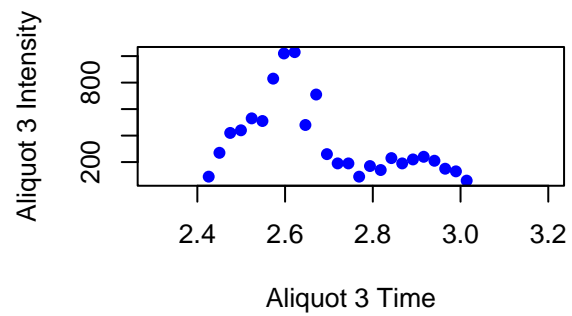


## Aliquot3 Time vs Intensity for Wal Pill2

## Aliquot1 Time vs Intensity for Wal Pill3



## Aliquot2 Time vs Intensity for Wal Pill3



## Aliquot3 Time vs Intensity for Wal Pill3
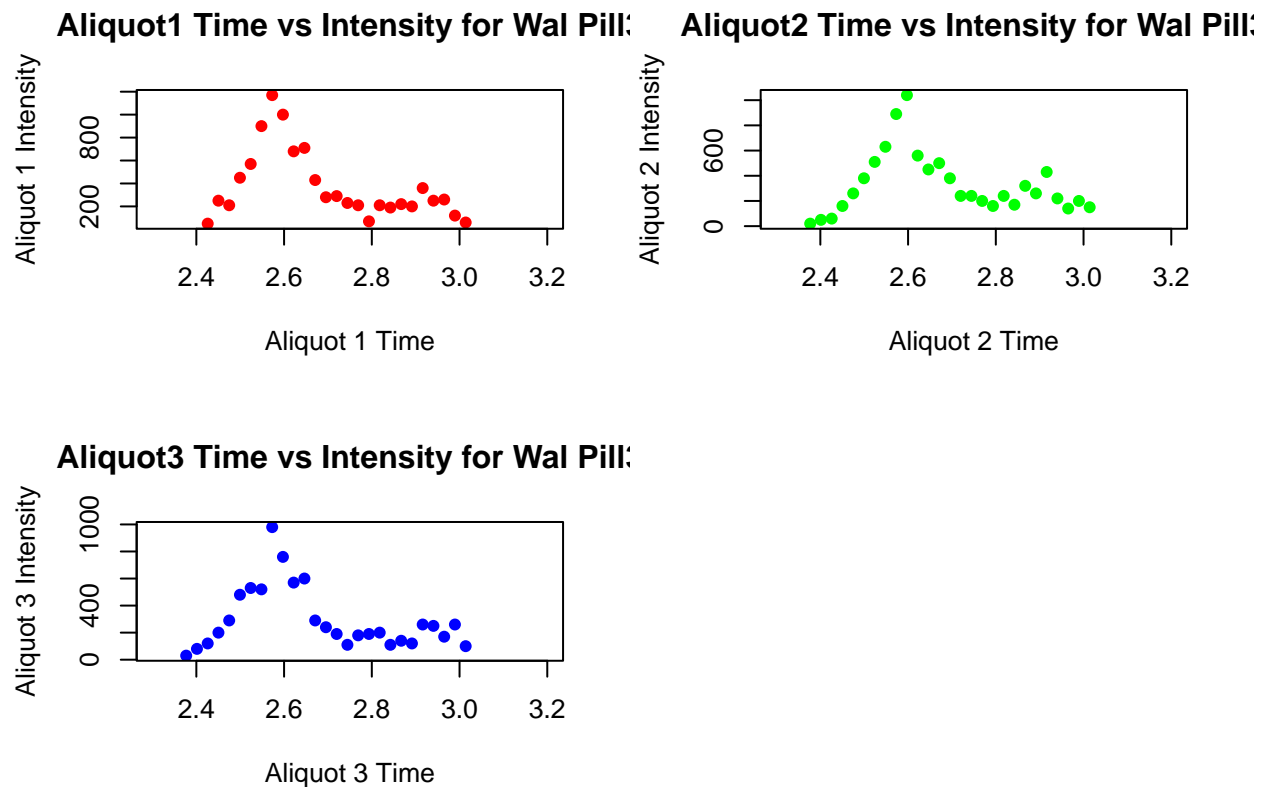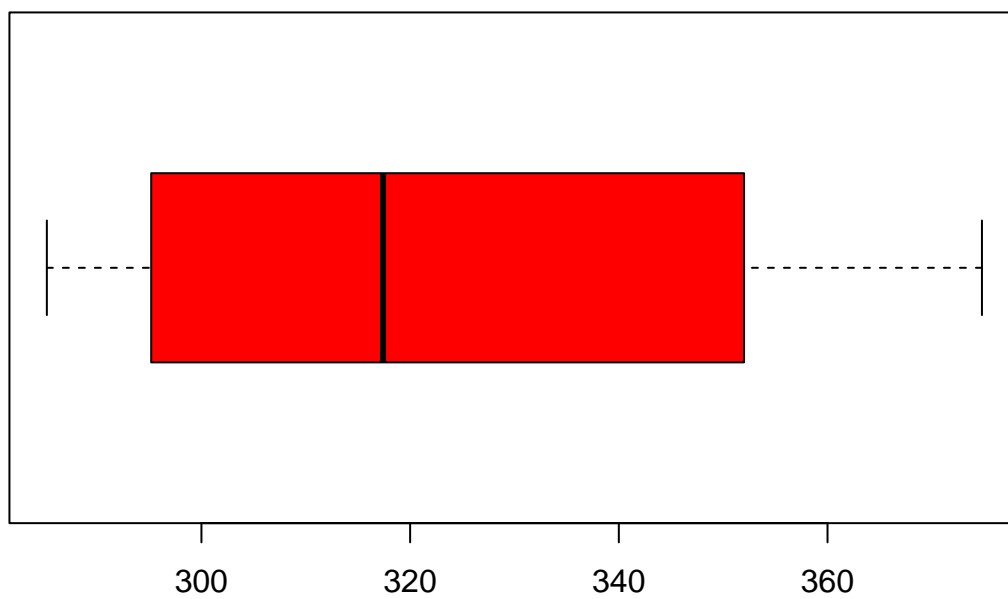


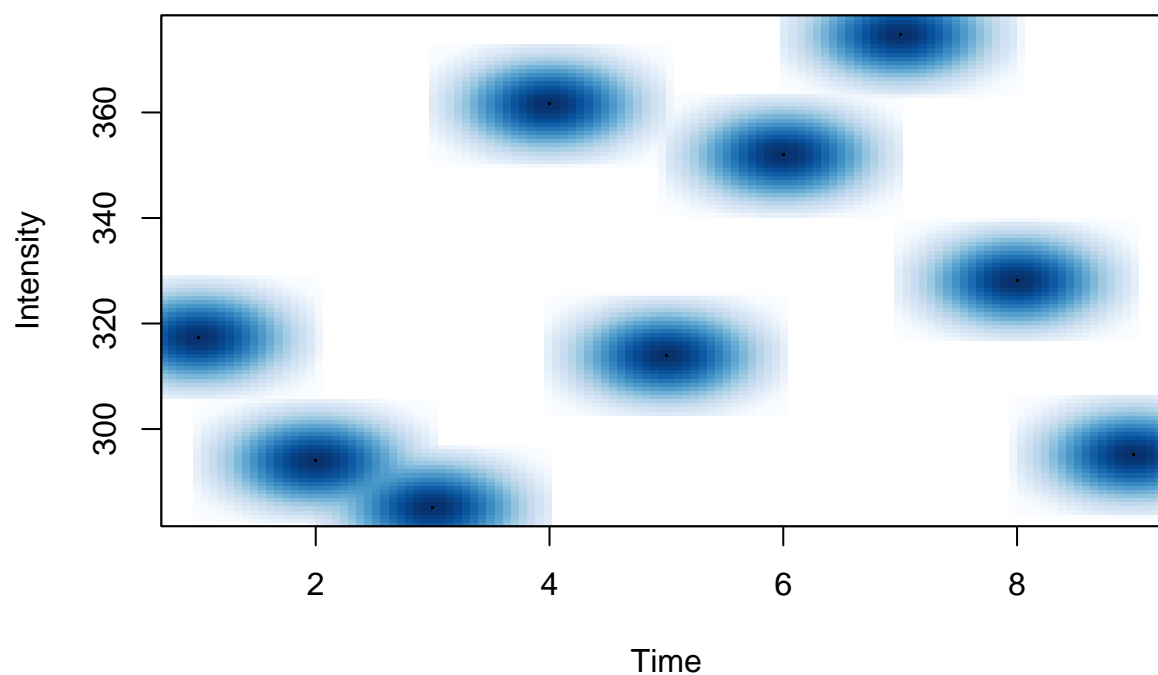## Average Wal Pill Intensities

## Data Visualization for Wal Pill Peak 240.00 137.100

```
##       WP.100
## Min.   :285.2
## 1st Qu.:295.2
## Median :317.4
## Mean   :324.7
## 3rd Qu.:352.0
## Max.   :374.8
```

**Boxplot of WP Pills: Peak 240.00 137.100**
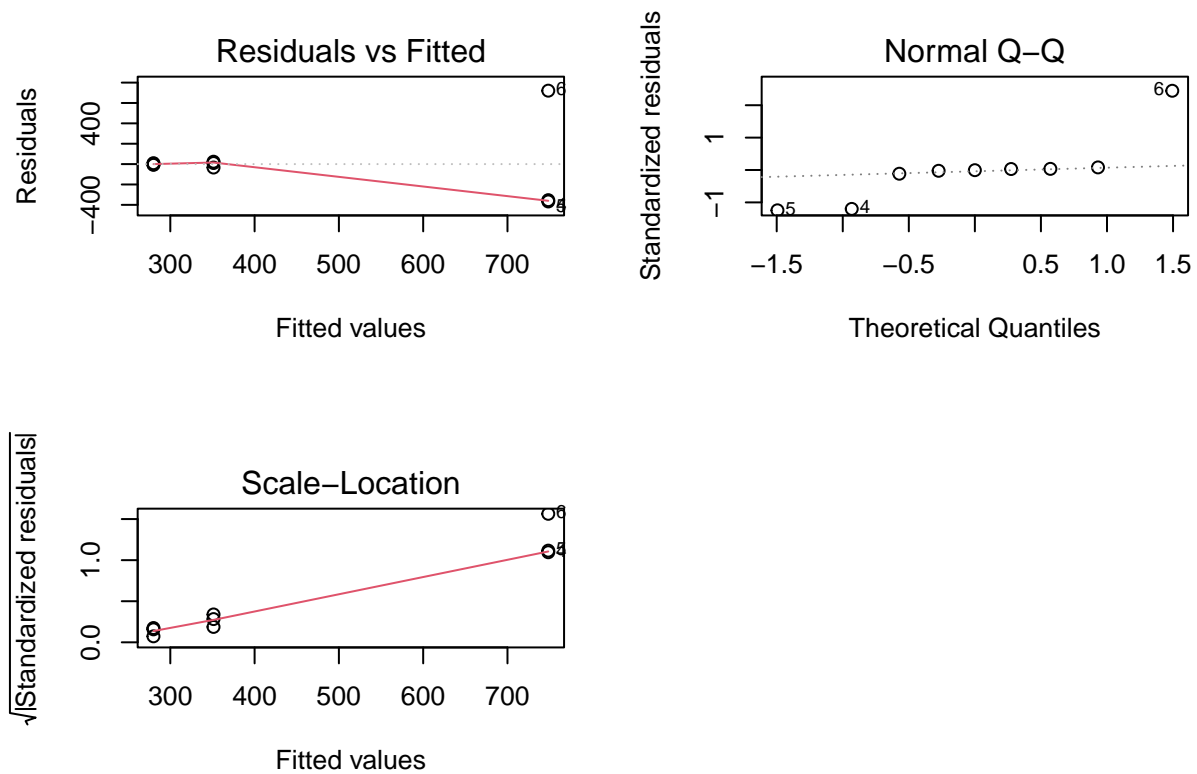
**Scatterplot for WP Pills from Peak 240.00 137.100**



## Anova of Peak 240.00 92.900
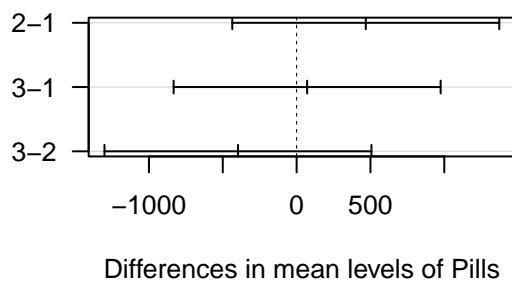
```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Pills        2 382129  191065   1.467  0.303
## Residuals    6 781241  130207
```

```
## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Intensity ~ Pills, data = da.100)
##
## $Pills
##            diff        lwr        upr      p adj
## 2-1   468.35417  -435.6397 1372.3481 0.3198597
## 3-1    71.24166  -832.7523  975.2356 0.9684499
## 3-2 -397.11251 -1301.1064  506.8814 0.4225520
```

119

**95% family–wise confidence level**



Differences in mean levels of Pills

The p-value of the pills variable is high (p >0.05), For this peak location, it appears that there are no substantial differences between the tablets. According to the findings of the post-hoc test, there are no statistically significant differences (p > 0.05) between pill groups.