Loading libraries

```
library(ggplot2)
```

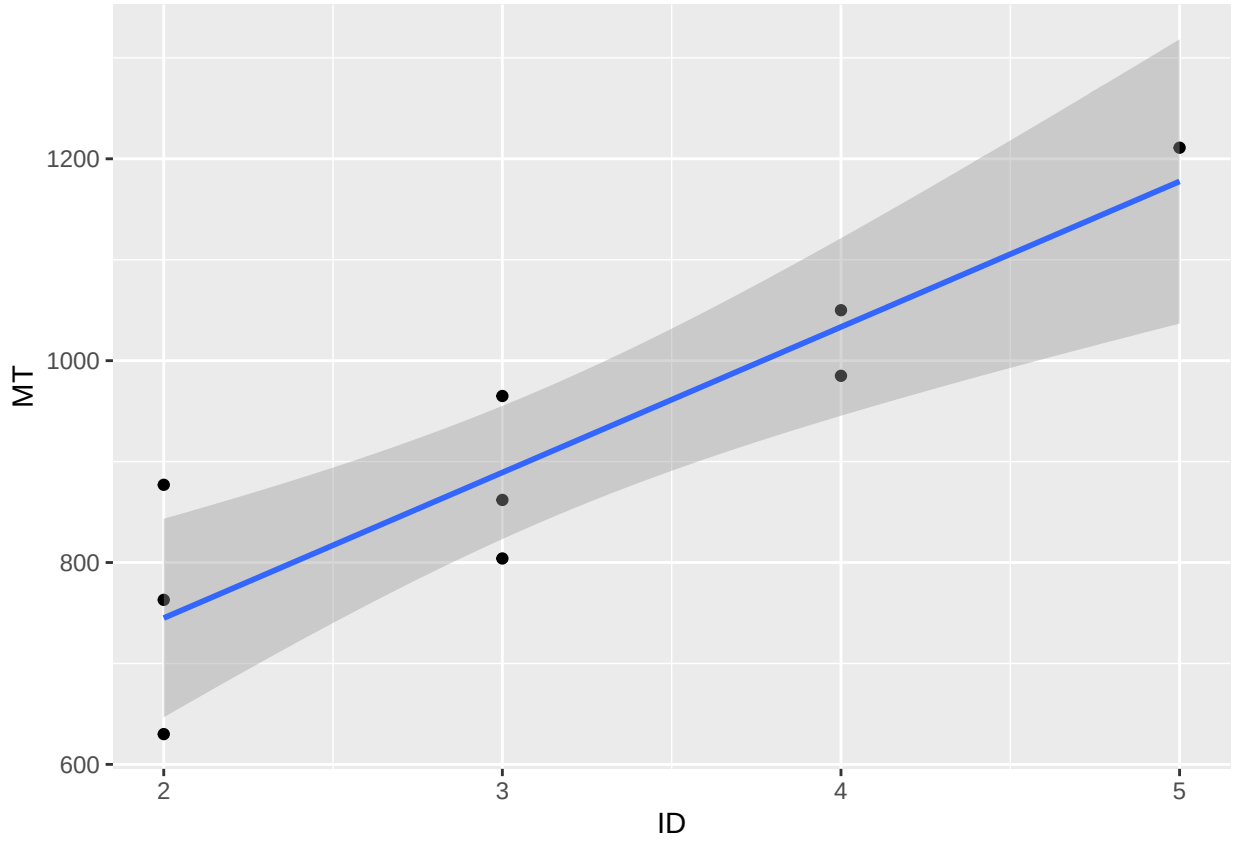
Loading data For the first experiment

```
library(readxl)
Data_Mean_128_16_first <- read_excel("Data_first_experiment_128_16/Data_Mean_128_16_first.xlsx")
Data_128_16_first <- read_excel("Data_first_experiment_128_16/Data_128_16_first.xlsx")
```

Plotting the data together with the linear regression

```
ggplot(Data_Mean_128_16_first, aes(ID, MT)) +
  geom_point() +
  geom_smooth(method='lm')
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



we can see little impact from ID TO MT, Let us go with linear model summary to see more details.

Linear modelling

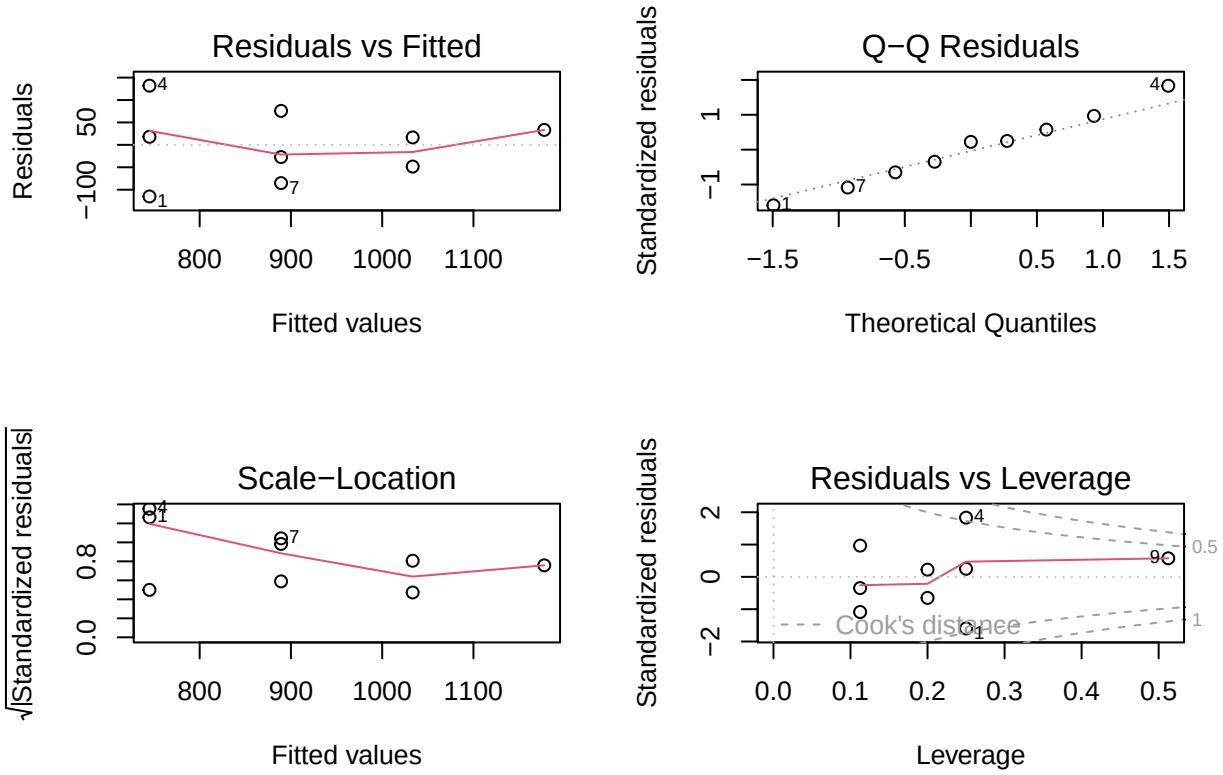
```
model1 <- lm(MT~ID, data = Data_Mean_128_16_first)
summary(model1)
```

```
##
## Call:
## lm(formula = MT ~ ID, data = Data_Mean_128_16_first)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -115.0  -48.4   16.6   33.4  132.0
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   456.60      91.14   5.010  0.00155 **
## ID            144.20      27.90   5.168  0.00130 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 83.2 on 7 degrees of freedom
## Multiple R-squared:  0.7923, Adjusted R-squared:  0.7626
## F-statistic:  26.7 on 1 and 7 DF,  p-value: 0.001299
```

Similary to Fitts' law says, ID does seem to have an impact on the movement time.

```
par(mfrow=c(2,2));plot(model1);par(mfrow=c(1,1))
```

Also, the R2=0.869 reported by the experimental software and the R2=0.7923 I find here, are different , but they are close to each other , but this for mean data not for Raw.



we can see from the residuLs VS Fitted there s no clear pattern (if i really undersant the pattern from this graph :)),

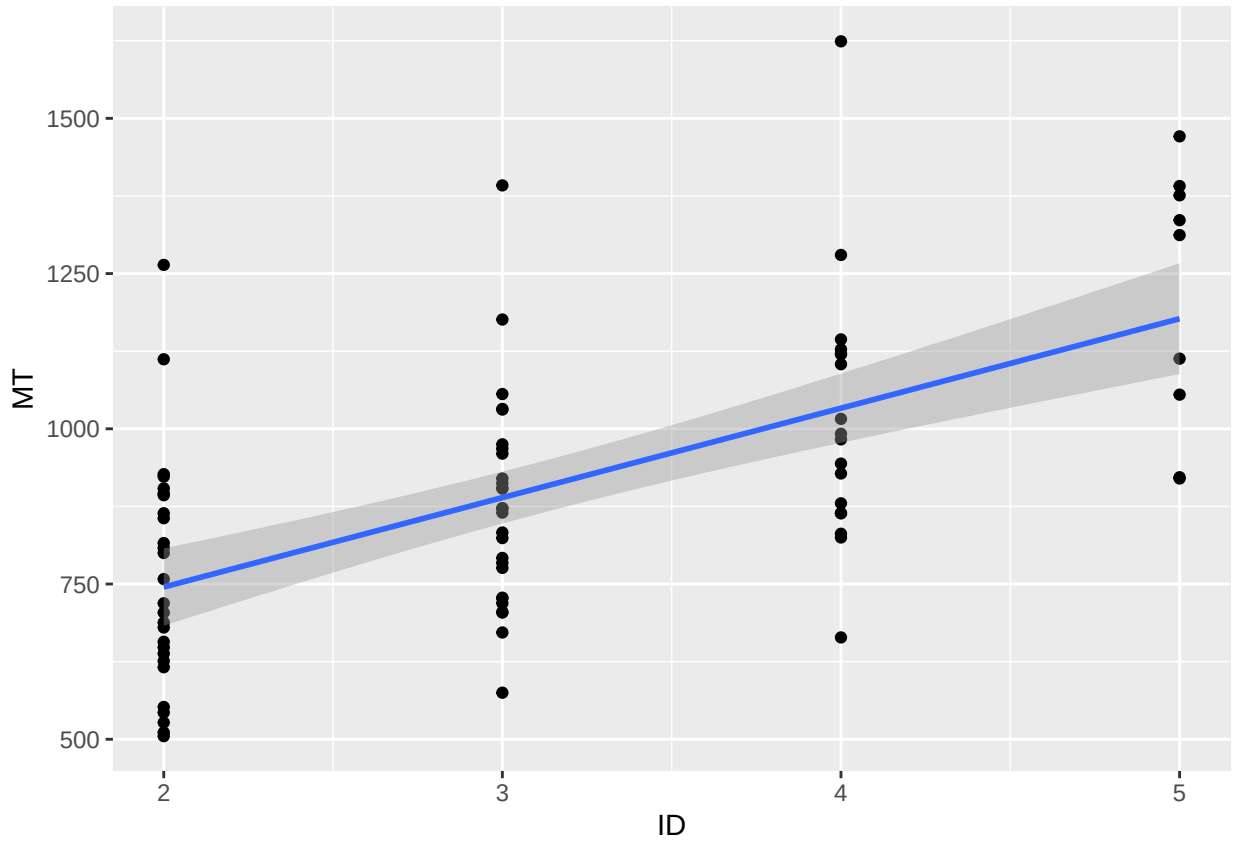
so we will not reject this model , and we can consider it good , also the pvalue it is inder 0.05 .

note this data for the mean not the raw.

```
ggplot(Data_128_16_first, aes(ID, MT)) +
  geom_point() +
  geom_smooth(method='lm')
```

now , same steps but for Raw Data.

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
model2 <- lm(MT~ID, data = Data_128_16_first)
summary(model2)
```

Here the we confuse more because the impact doesnt appear that much and we have more variablity between the points.

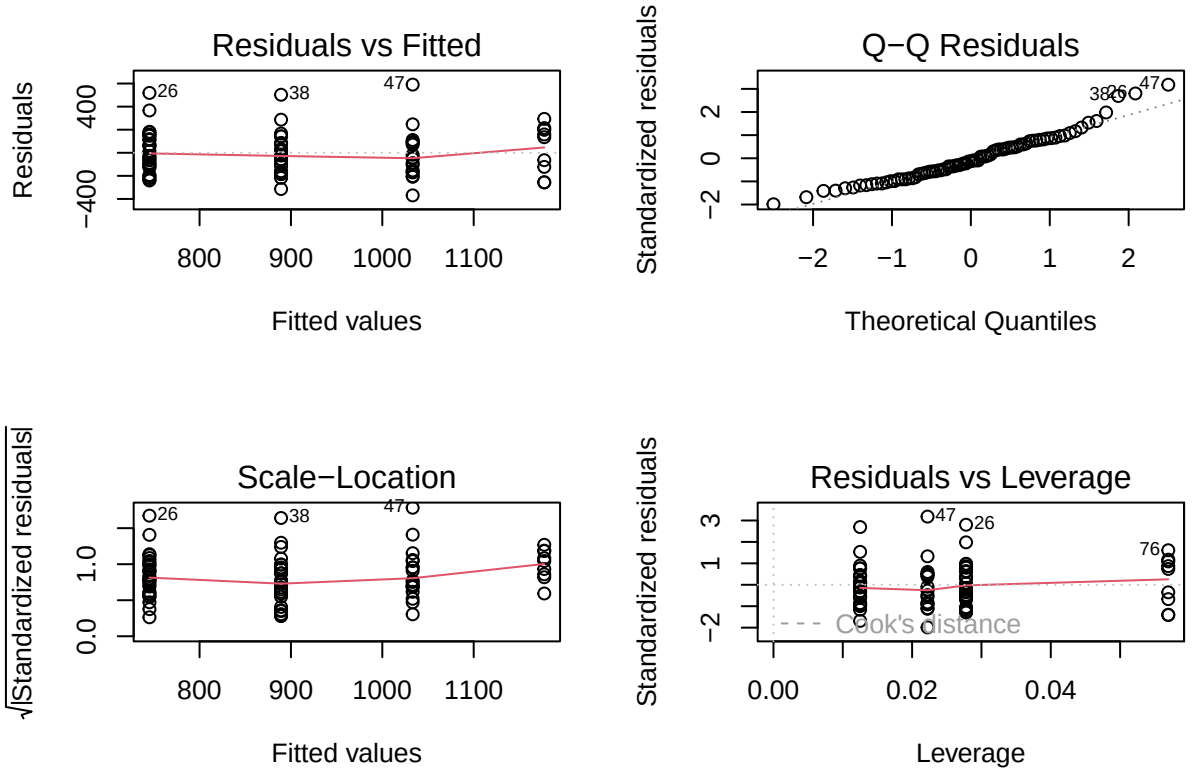
```
##
## Call:
## lm(formula = MT ~ ID, data = Data_128_16_first)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -369.22 -129.17  -24.19  110.83  590.78
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   457.11      68.59   6.665 3.25e-09 ***
## ID            144.03      21.00   6.858 1.39e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 187.8 on 79 degrees of freedom
## Multiple R-squared:  0.3732, Adjusted R-squared:  0.3653
```

```
## F-statistic: 47.04 on 1 and 79 DF,  p-value: 1.393e-09
```

From the summary we can see the R-squared is smaller for Raw data ,that mean there are alot of residuals are not explained by the model.

Plotting the residuals vs fitted.

```
par(mfrow=c(2,2));plot(model2);par(mfrow=c(1,1))
```



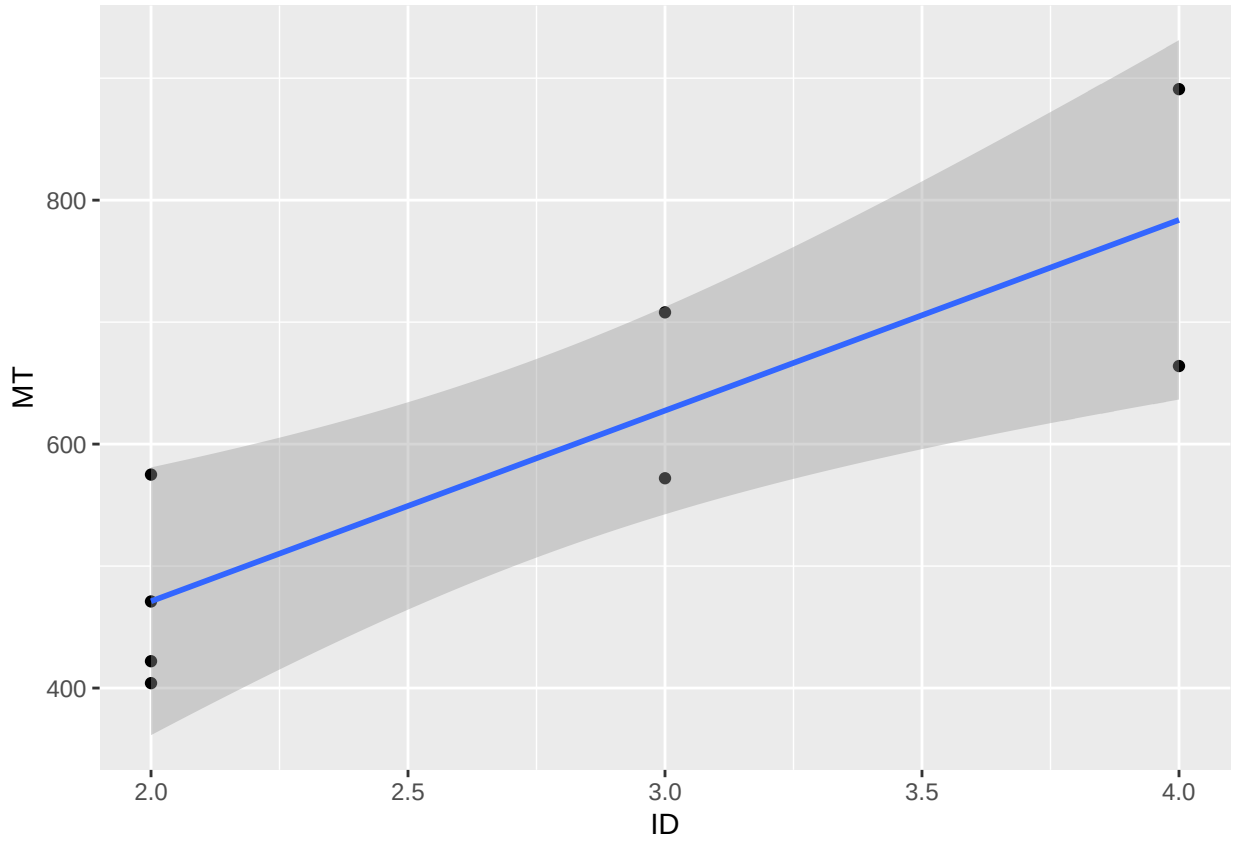
From the ploting graph we cant see there is a real impact from ID on MT , but for the model we can see the fitted vs residuals we cant reject the model and we can see the p value less than 0.05 which is good so we can go with this model ,but the movement values will not just depend on ID , there are factors like the device we use , the age of person , how much he concetrate , does he did somthing else while he doing the experiment , does he use mouse or something else.

Second Experiment , with same steps from above.

```
library(readxl)
Data_Mean_12_6_second <- read_excel("Data_second_experiment_12_6/Data_Mean_12_6_second.xlsx")
Data_12_6_second <- read_excel("Data_second_experiment_12_6/Data_12_6_second.xlsx")
```

```r
ggplot(Data_Mean_12_6_second, aes(ID, MT)) +
  geom_point() +
  geom_smooth(method='lm')
```

```
## `geom_smooth()` using formula = 'y ~ x'
```




```r
model3 <- lm(MT~ID, data = Data_Mean_12_6_second)
summary(model3)
```

we cant see the real impact of ID on MT.

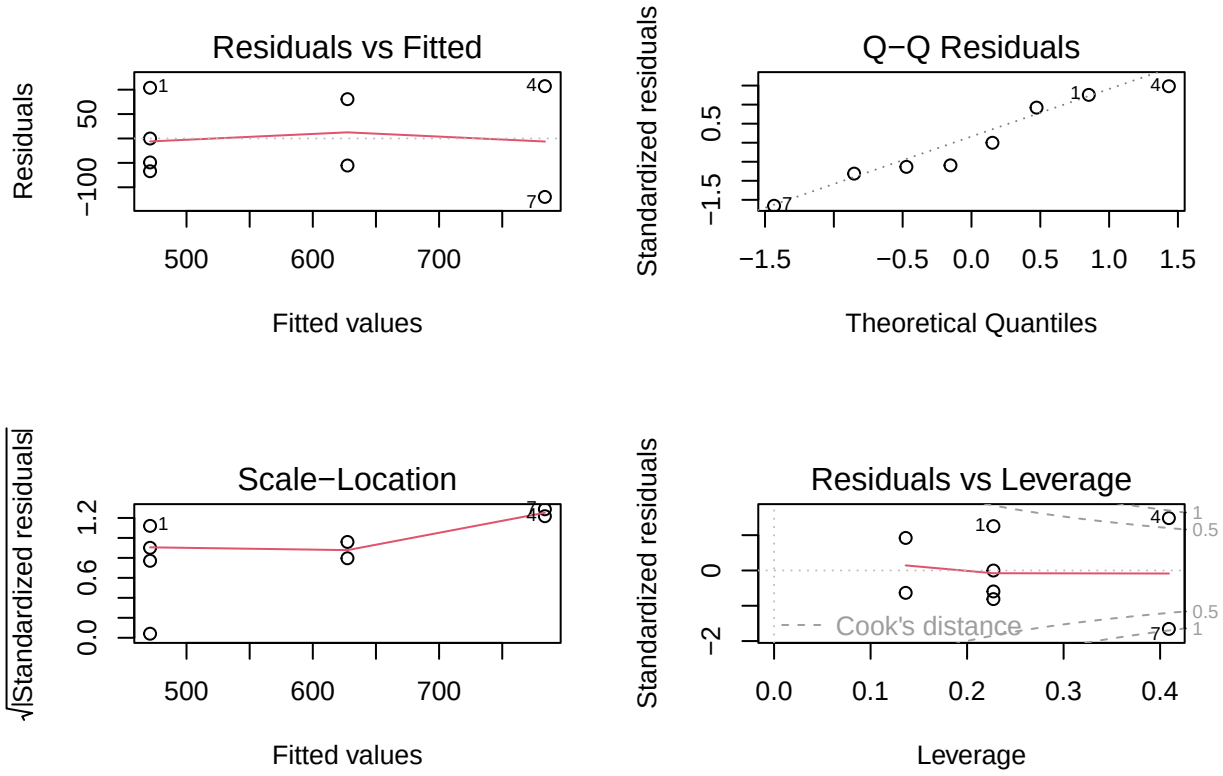
```
##
## Call:
## lm(formula = MT ~ ID, data = Data_Mean_12_6_second)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -119.77  -58.38  -24.64   86.38  107.23
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)   158.50     115.23   1.375  0.21813
## ID            156.32      40.12   3.896  0.00802 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 94.09 on 6 degrees of freedom
## Multiple R-squared:  0.7167, Adjusted R-squared:  0.6695
## F-statistic: 15.18 on 1 and 6 DF,  p-value: 0.008018
```

The R-squared bigger than we get from the software 0.640,becuase we reduce the data,still we will not reject the

model,since we have p-value less than 0.05 and there is impact for ID on MT without forgetting the impact for other

```
par(mfrow=c(2,2));plot(model3);par(mfrow=c(1,1))
```



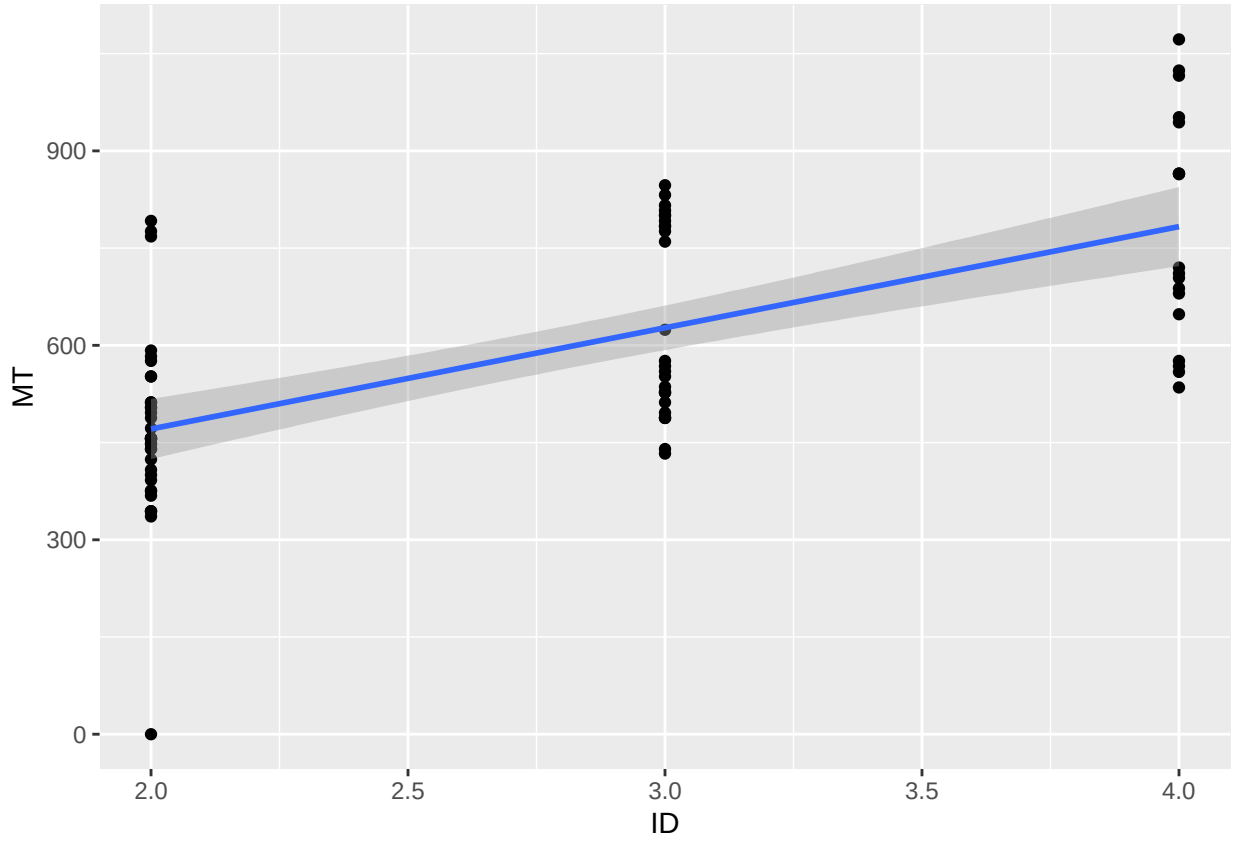
factors.

Also from this graph residual vs fitted so we cant see the pattern so we cant reject the model , and there is a little impact from the ID on th MT but As I said above there are another factors.

```
ggplot(Data_12_6_second, aes(ID, MT)) +
  geom_point() +
  geom_smooth(method='lm')
```

Now for Raw Data,

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
model4 <- lm(MT~ ID, data = Data_12_6_second)
summary(model4)
```

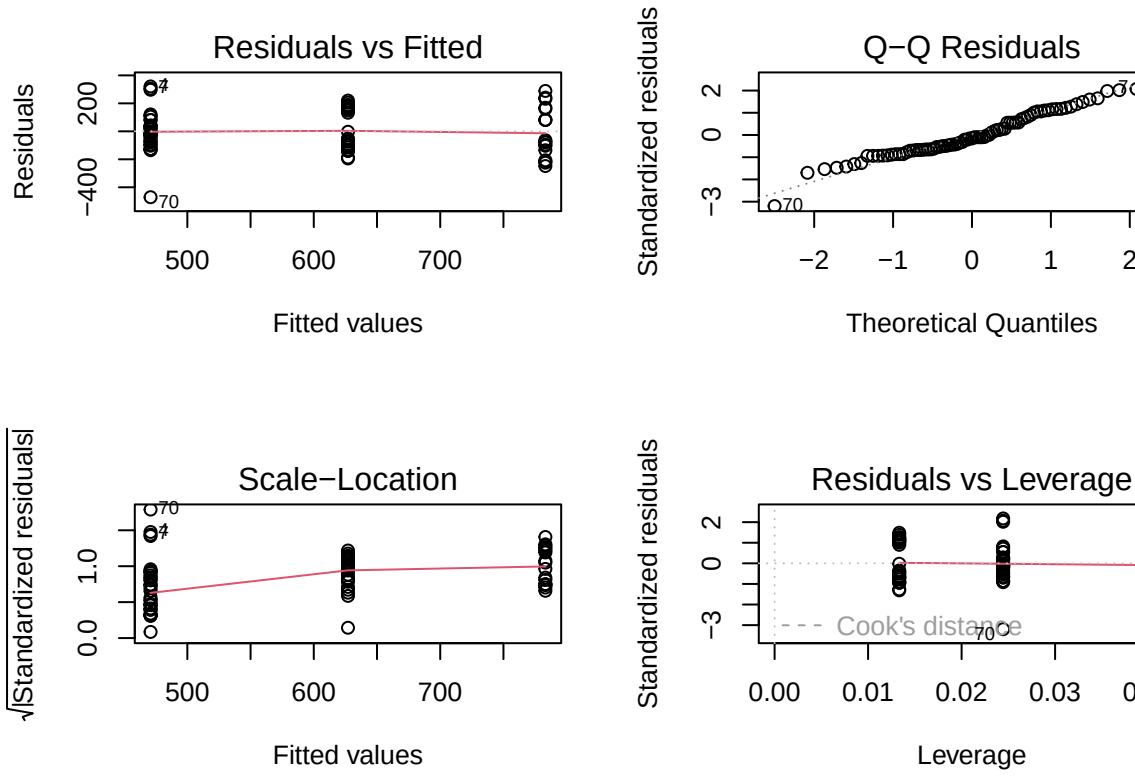
```
##
## Call:
## lm(formula = MT ~ ID, data = Data_12_6_second)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -470.92 -100.05  -22.92  112.08  321.08
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   158.67      60.87   2.607   0.0109 *
```

```
## ID            156.13      21.08   7.405 1.25e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 149.1 on 79 degrees of freedom
## Multiple R-squared:  0.4097, Adjusted R-squared:  0.4022
## F-statistic: 54.83 on 1 and 79 DF,  p-value: 1.246e-10
```

The R-sequared smaller than above (Mean Data)and smaller than we get from the software which was 0.640,

```
par(mfrow=c(2,2));plot(model4);par(mfrow=c(1,1))
```

Note:maybe because we reduce the number of points so the R-squared wasnt accurate in mean



Data, and was bigger.

We can't reject the model here, there are another factors have impact on the movement related to the human and the device.

Note:also there is important thing , which is we don't know how they are calculate the R-squared in their software.