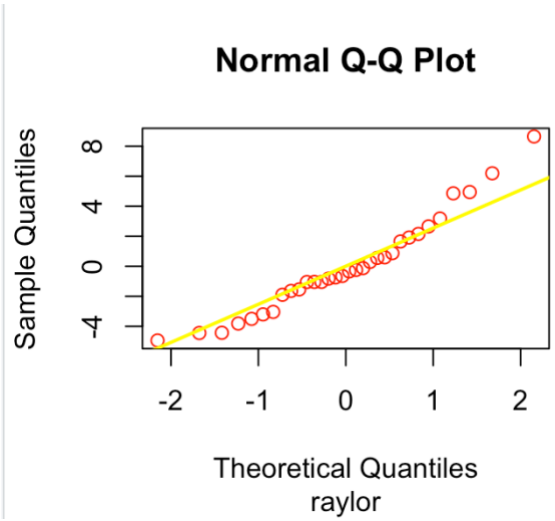

Bp: H_0: *Equal Variance* $\sigma^2(\varepsilon_i) = \sigma^2$ *vs* H_a: *Unequal Variance*

BP = 0.19869, df = 1, p-value = 0.6558> 0.05

We cannot reject null hypothesis. There is no significant evidence that the variances are unequal.

Dw Test:

H_0: *Errors are uncorrelated over time* H_a: *Errors are positively correlated*

DW = 1.3826, p-value = 0.03109<0.05, We reject null hypothesis. There is significant evidence that the errors are positively correlated.

Sw:

H_0: *Errors are from normal distibution* H_a: *Errors are not from normal distribution*

W = 0.9533, p-value = 0.1788>0.05, We reject null hypothesis. There is significant evidence that the errors are not from normal distribution.

```
> data("mtcars")
> mtcars
                   mpg cyl  disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
Valiant           18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
Duster 360        14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
Merc 240D         24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
Merc 230          22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
Merc 280          19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
Merc 280C         17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
```

```
Merc 450SE          16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
Merc 450SL          17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
Fiat 128            32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
> plot(mtcars$mpg~mtcars$hp, xlab="hp",ylab = "mpg", main="mpg vs hp",sub="raylor")
> plot(mtcars$mpg~mtcars$drat, xlab="hp",ylab = "mpg", main="mpg vs drat",sub="raylor")
> plot(mtcars$mpg~mtcars$wt, xlab="hp",ylab = "mpg", main="mpg vs wt",sub="raylor")
> plot(mtcars$mpg~mtcars$qsec, xlab="hp",ylab = "mpg", main="mpg vs qsec",sub="raylor")
> regmodel=lm(mtcars$mpg~mtcars$wt)
> summary(r)

Call:
lm(formula = mtcars$mpg ~ mtcars$wt)

Residuals:
    Min      1Q  Median      3Q     Max
-4.5432 -2.3647 -0.1252  1.4096  6.8727

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  37.2851     1.8776  19.858  < 2e-16 ***
mtcars$wt    -5.3445     0.5591  -9.559 1.29e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.046 on 30 degrees of freedom
Multiple R-squared:  0.7528,  Adjusted R-squared:  0.7446
F-statistic: 91.38 on 1 and 30 DF,  p-value: 1.294e-10
> plot(mtcars$mpg~mtcars$wt, xlab="hp",ylab = "mpg", main="mpg vs wt",sub="raylor")
```

```
> abline(lm(mtcars$mpg~mtcars$wt))
> confint(regmodel)
                2.5 %    97.5 %
(Intercept) 33.450500 41.119753
mtcars$wt   -6.486308 -4.202635
>mpg= mtcars$mpg
>  wt= mtcars$wt
.newdata = data.frame(wt=1.5)
> predict(regmodel, newdata, interval="confidence")
       fit     lwr      upr
1 29.26842 27.0203 31.51653
>mean(wt)
> newdataa = data.frame(wt=3.21725)
> predict(regmodel, newdataa, interval="confidence")
> predict(regmodel, newdataa, interval="prediction")
> standard_res <- rstandard(regmodel)
> plot(regmodel$fitted.values,standard_res,main="b5,Raylor",xlab="Fitted
values",ylab="Standardized Residual")
> abline(h=c(-2,0,2),col=c(2,1,2),lty=c(1,2,1))
> data<- data.frame(mpg, wt)
> new.data<- data[abs(rstandard(regmodel))<2 , ]
> reg=lm(new.data
+ )
> summary(reg)

Call:
lm(formula = new.data)

Residuals:
   Min      1Q  Median      3Q     Max
-3.8700 -1.8324 -0.0635  1.5353  4.8339

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  36.1376     1.6200   22.31  < 2e-16 ***
wt           -5.1948     0.4846  -10.72 3.13e-11 ***
---
Signif. codes:
0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.283 on 27 degrees of freedom
Multiple R-squared:  0.8098,  Adjusted R-squared:  0.8027
F-statistic: 114.9 on 1 and 27 DF,  p-value: 3.126e-11
> plot(new.data$mpg~new.data$wt, xlab="hp",ylab = "mpg", main="mpg vs wt",sub="raylor")
> abline(lm(new.data$mpg~new.data$wt))
> regmodel1= lm(mpg~hp)
```

```
> summary(regmodel1)

Call:
lm(formula = mpg ~ hp)

Residuals:
    Min      1Q  Median      3Q     Max
-5.7121 -2.1122 -0.8854  1.5819  8.2360

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 30.09886    1.63392  18.421  < 2e-16 ***
hp          -0.06823    0.01012  -6.742 1.79e-07 ***
---
Signif. codes:
0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.863 on 30 degrees of freedom
Multiple R-squared:  0.6024,  Adjusted R-squared:  0.5892
F-statistic: 45.46 on 1 and 30 DF,  p-value: 1.788e-07
> mean(hp)
[1] 146.6875
>  newdata1= data.frame(hp=146.6875)
>  predict (regmodel1, newdata1, interval="confidence")
       fit      lwr      upr
1 20.09062 18.69599 21.48526
>  predict (regmodel1, newdata1, interval="prediction")
       fit      lwr      upr
1 20.09062 12.07908 28.10217
>
> plot(regmodel1$fitted.values,regmodel1$residuals,main=" Residuals vs Fitted values \raylor",
+      xlab="Fitted values",ylab="Residual")
> abline(h=0,col="red")
> bptest(regmodel1, studentize=FALSE)

            Breusch-Pagan test

data:  regmodel1
BP = 0.047689, df = 1, p-value = 0.8271

> plot (regmodel1$fitted.values, regmodel1$residuals, main="Residual Plot", sub=
"raylor",xlab="Fitted values",ylab="Residual")
> abline(h=0, col="red")
> abline(h=0,col="red")
> plot(regmodel1$residuals, ylab="Residuals",main="Residual time sequence Plot")
> abline(h=0,col="red")
```

```
> plot(regmodel1$residuals, ylab="Residuals",main="Residual time sequence Plot \n raylor")
> abline(h=0,col="red")
> qqline(resid(regmodel1), col = "red", lwd = 2)
>
> qqnorm(resid(regmodel1), main = "Normal Q-Q Plot \n raylor", col = "darkgrey")
> qqline(resid(regmodel1), col = "red", lwd = 2)
> dwtest(mpg~hp)

        Durbin-Watson test

data:  mpg ~ hp
DW = 1.1338, p-value = 0.00411
alternative hypothesis: true autocorrelation is greater than 0

> shapiro.test(resid(regmodel1))

        Shapiro-Wilk normality test

data:  resid(regmodel1)
W = 0.92337, p-value = 0.02568
> loghp=log(hp)
> re = lm(mpg~loghp)
> summary(re)

Call:
lm(formula = mpg ~ loghp)

Residuals:
   Min      1Q  Median      3Q     Max
-4.9427 -1.7053 -0.4931  1.7194  8.6460

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   72.640      6.004  12.098 4.55e-13 ***
loghp        -10.764      1.224  -8.792 8.39e-10 ***
---
Signif. codes:
0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.239 on 30 degrees of freedom
Multiple R-squared:  0.7204,  Adjusted R-squared:  0.7111
F-statistic:  77.3 on 1 and 30 DF,  p-value: 8.387e-10
> plot (mpg~loghp, main="mpg vs log(hp)", sub="raylor")
> abline(lm(mpg~loghp))
.>scheffe(re,data.frame(hp=80))
>scheffe(re,data.frame(hp=160))
```

```
>scheffe(re,data.frame(hp=240))
> plot(mpg~loghp, main=" mpg vs log(hp)", sub="raylor")
> abline(lm(mpg~loghp))
> plot (re$fitted.values,re$residuals, main="Residual Plot", sub= "ray",xlab="Fitted
values",ylab="Residual")
> abline(h=0, col="red")
> plot(re$residuals, ylab="Residuals",main="Residual time sequence Plot", sub= "raylor")
> abline(h=0, col="red")
> qqnorm(resid(re), main = "Normal Q-Q Plot", col = "red", sub="raylor")
> qqline(resid(re), col = "yellow", lwd = 2)
> bptest (re, studentize = FALSE)

        Breusch-Pagan test

data:  re
BP = 0.19869, df = 1, p-value = 0.6558

> dwtest(mpg~loghp)

        Durbin-Watson test

data:  mpg ~ loghp
DW = 1.3826, p-value = 0.03109
alternative hypothesis: true autocorrelation is greater than 0

> bptest(re, studentize=FALSE)

        Breusch-Pagan test

data:  re
BP = 0.19869, df = 1, p-value = 0.6558

> dwtest(mpg~loghp)

        Durbin-Watson test

data:  mpg ~ loghp
DW = 1.3826, p-value = 0.03109
alternative hypothesis: true autocorrelation is greater than 0

> shapiro.test(resid(re))

        Shapiro-Wilk normality test

data:  resid(re)
W = 0.9533, p-value = 0.1788
```