Lab 9: Diagnostics

1. Using the cars2010 data set, run the regression with the following explanatory variables:

EngDispl
Transmission
AirAspirationMethod
TransLockup
TransCreeperGear
DriveDesc
IntakeValvePerCyl
CarlineClassDesc
VarValveLift

```
lm.model=lm(FE~EngDispl+Transmission+AirAspirationMethod+TransLockup+TransCreeperGear+DriveDesc+IntakeValvePerCyl+CarlineClassDesc+VarValveLift,data=cars2010)
```

a. Let's assume that these observations are ordered throughout time (observation 1 was the first to be observed in time, observation 2 was the 2nd and so forth), check for 1st order autocorrelation using the Durbin-Watson test.

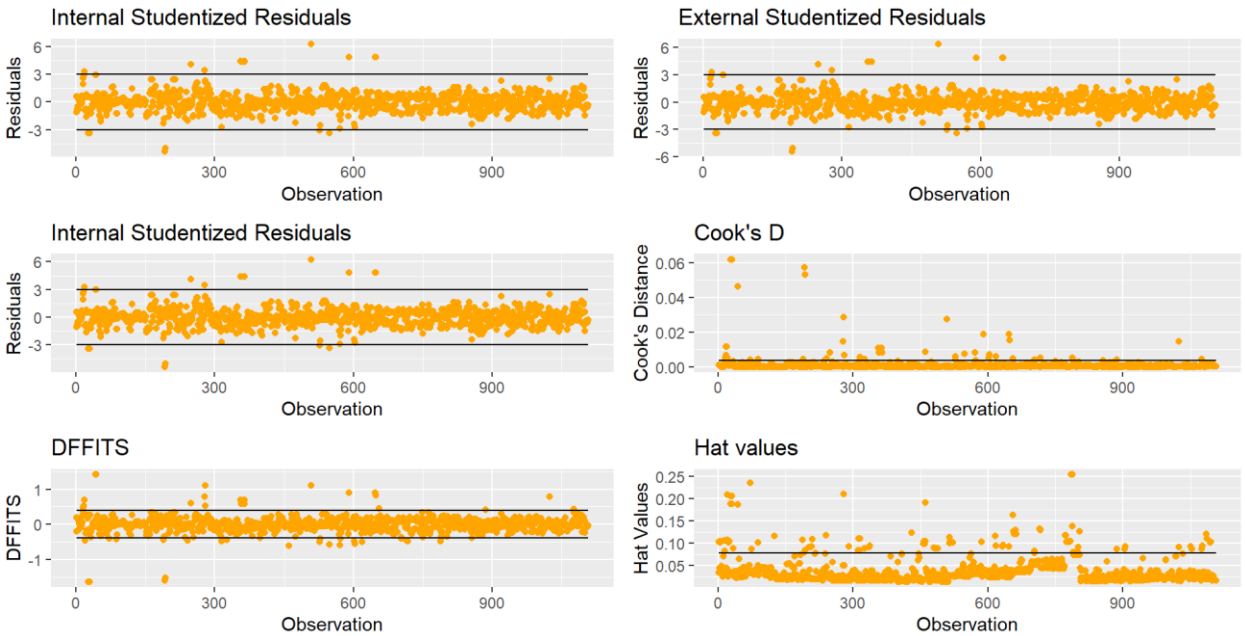
```
> dwtest(lm.model,alternative="greater")

        Durbin-Watson test

data:  lab.model

DW = 1.3354, p-value < 2.2e-16

alternative hypothesis: true autocorrelation is greater than 0
```

H_0: No Autocorrelation H_A: Autocorrelation, with a test statistic of 1.3354 and a p-value less than 2.2×10^{-16}, we will reject the null hypothesis. There does appear to be significant 1st order autocorrelation present in the data.

b. Use plots to identify potential influential observations based on the suggested cutoff values.

```
> a = ggplot(lm.model,aes(x=n.index,y=rstandard(lm.model)))+geom_point(color="orange")+geom_line(y=-3)+geom_line(y=3)+labs(title = "Internal Studentized Residuals",x="Observation",y="Residuals")

> b = ggplot(lm.model,aes(x=n.index,y=rstudent(lm.model)))+geom_point(color="orange")+geom_line(y=-3)+geom_line(y=3)+labs(title = "External Studentized Residuals",x="Observation",y="Residuals")

> ##Influential points
```

```
> c =
ggplot(lm.model,aes(x=n.index,y=rstandard(lm.model)))+geom_point(color="orange")+geom_line(y=-
3)+geom_line(y=3)+labs(title = "Internal Studentized Residuals",x="Observation",y="Residuals")

> ##Cook's D

> D.cut=4/(nrow(cars2010)-lm.model$rank)

> d
=ggplot(lm.model,aes(x=n.index,y=cooks.distance(lm.model)))+geom_point(color="orange")+geom_line
(y=D.cut)+labs(title = "Cook's D",x="Observation",y="Cook's Distance")

> ##Dffit

> df.cut=2*(sqrt(lm.model$rank/nrow(cars2010)))

> e
=ggplot(lm.model,aes(x=n.index,y=dffits(lm.model)))+geom_point(color="orange")+geom_line(y=df.cut)
+geom_line(y=-df.cut)+labs(title = "DFFITS",x="Observation",y="DFFITS")

> db.cut=2/sqrt(nrow(cars2010))

> ##Hat

> hat.cut=2*(lm.model$rank)/nrow(cars2010)

> h =
ggplot(lm.model,aes(x=n.index,y=hatvalues(lm.model)))+geom_point(color="orange")+geom_line(y=hat
.cut)+labs(title = "Hat values",x="Observation",y="Hat Values")

> grid.arrange(a,b,c,d,e,h,ncol=2)
```



c. Are there any observations with a dffits larger than 1 AND studentized residuals larger than 3 in magnitude? If so, list the observations.

There is 1 observation (observation #1596:

```
> newcar2<-cbind(cars2010,rstudent(lm.model),dffits(lm.model))

> newcar2[abs(newcar2$Rstudent)>=3 & newcar2$Dffits>=1,]

     EngDispl NumCyl Transmission  FE     AirAspirationMethod NumGears
1596  1.8      4      AV     69.6404  NaturallyAspirated        1

TransLockup    TransCreeperGear          DriveDesc      IntakeValvePerCyl
       0            0                TwoWheelDriveFront        2

ExhaustValvesPerCyl   CarlineClassDesc VarValveTiming VarValveLift Rstudent
       2               MidsizeCars          1            0          6.38526

Dffits
     1.110306
```