Question 5.1

Using crime data from the file `uscrime.txt` (http://www.statsci.org/data/general/uscrime.txt, description at http://www.statsci.org/data/general/uscrime.html), test to see whether there are any outliers in the last column (number of crimes per 100,000 people). Use the `grubbs.test` fu nction in the `outliers` package in R.

Solution:

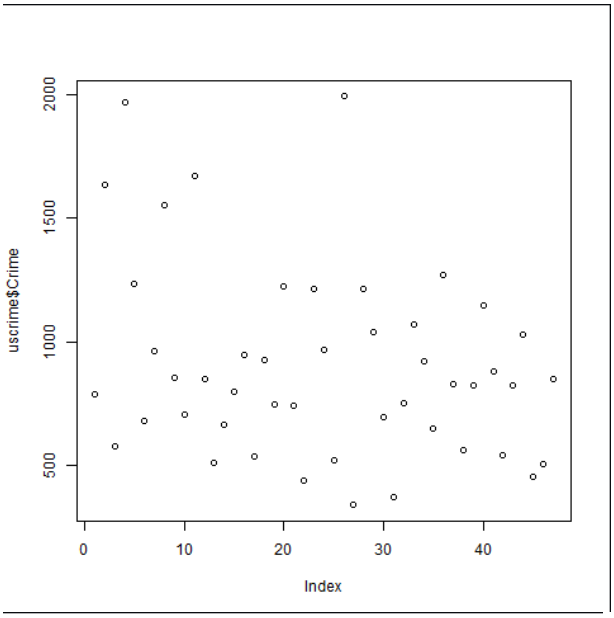
Full code used and results underneath:

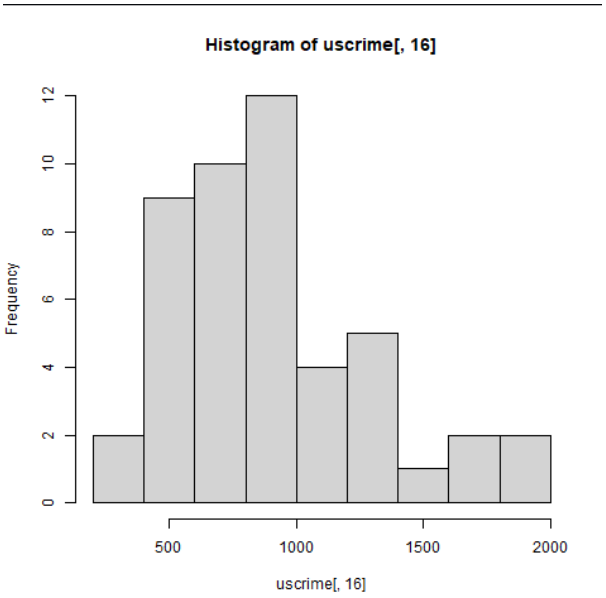
```
setwd("C:/Users/……..")

uscrime <- read.table("uscrime.txt", stringsAsFactors = FALSE, header = T)
head(uscrime)

summary(uscrime$Crime)

library(outliers)

#plot in a variety of ways for visual confirmation of predicted outliers
plot(uscrime$Crime)
plot(uscrime[,16],type ="b")
hist(uscrime[,16],type ="b")
qqnorm(uscrime$Crime)
boxplot(uscrime$Crime)

#grubbs test for outliers
grubbs.test(uscrime$Crime, type = 10)

#remove first outlier found and plot again before testing dataset again
crime1<- uscrime[-26,16]
plot(crime1)
boxplot(crime1)

#grubbs test #2 and remove second outlier found
grubbs.test(crime1, type = 10)
crime2<- crime1[-4]
plot(crime2)

#grubbs test #3
grubbs.test(crime2, type = 10)
hist(crime2)
boxplot(crime2)
```

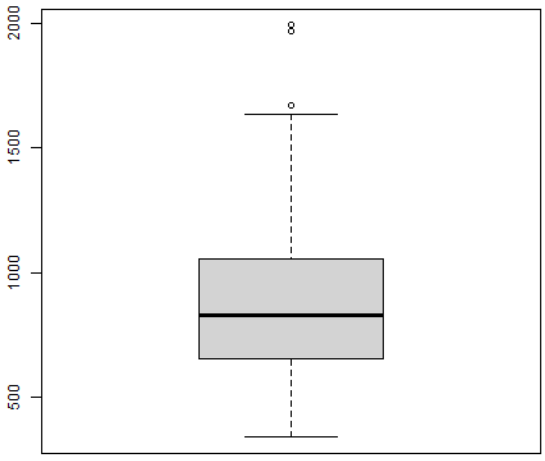
Data set summary:

```
> summary(uscrime$Crime)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  342.0   658.5   831.0   905.1  1057.5  1993.0
```

Initial data plots:



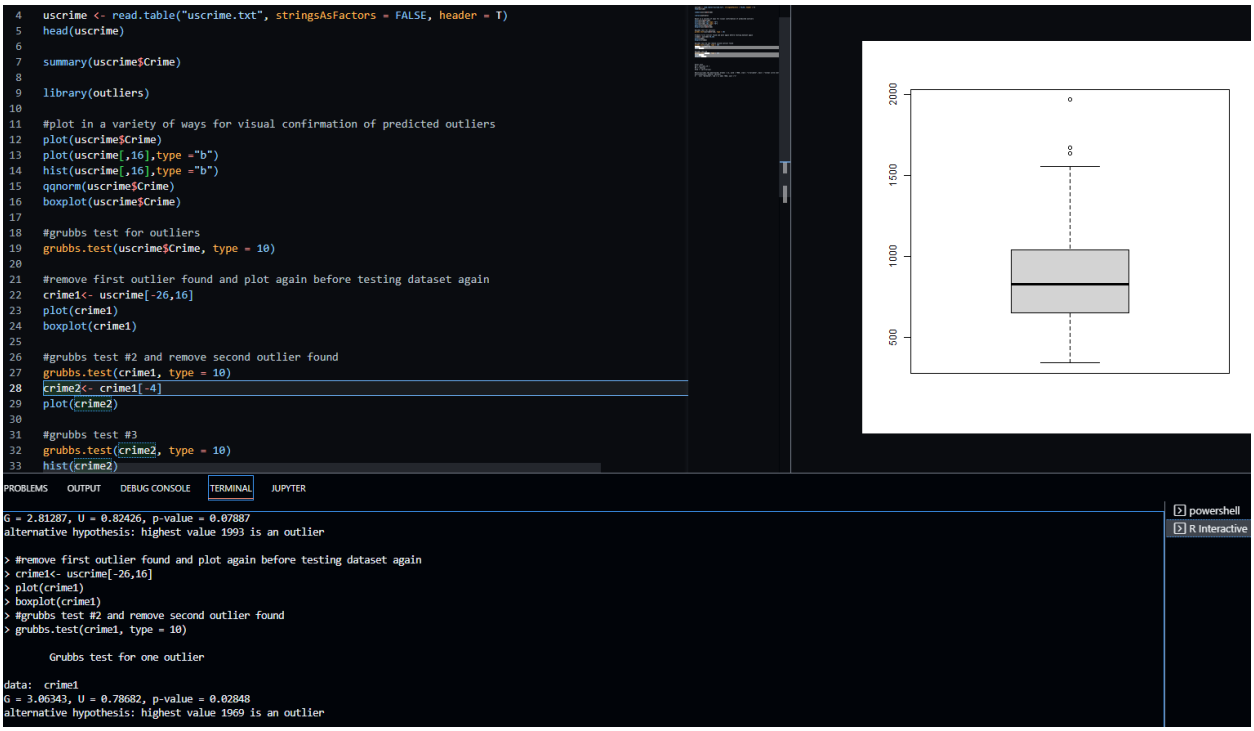




First Grubbs test showing there's over a 7% chance that we'd encounter an outlier so far from the others by chance alone, if all data were really sampled from a simple Gaussian normal distribution. Under 5% would normally be what we look for but based on the plots this will be considered an outlier and eliminated.

```
data:  uscrime$Crime
G = 2.81287, U = 0.82426, p-value = 0.07887
alternative hypothesis: highest value 1993 is an outlier
```

Elimination of row 26 and grubbs test #2. Row 4 is now also an outlier with a p-value = 0.0284 after the removal of the first outliers and that is also removed.



Grubbs test #3 for additional outliers were ran and though the code determines that value 1674 is an outlier, the p-value = 0.178 so this data point is not eliminated.

```
31  #grubbs test #3
32  grubbs.test(crime2, type = 10)
33  hist(crime2)
34  boxplot(crime2)
35
36
37
38
```

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```
        Grubbs test for one outlier

data:  crime2
G = 2.56457, U = 0.84712, p-value = 0.1781
alternative hypothesis: highest value 1674 is an outlier
```

Final data plots after all outliers are removed.