Homework #1

1) Targeted population: Population of USA
Sampling population: 34,000 random chosen individuals
Sample: Individuals who answered the questionnaire
Parameter: Proportion of all smokers who died due to heart disease
Statistic: Proportion of smokers who have died due to heart disease in sample

This is an observational study and not controlled experiment because we are not assigning people to groups.

We cannot draw a conclusion that smoking causes heart disease as this is not a controlled experiment.

2) Targeted population: Households in the continental United States
Sampling population: 500 households in the continental United States
Sample: Individuals who answered the 50 questionnaires
Parameter: Consumer sentiment score
Statistic: Mean of the consumer sentiment score

3) It is given that Mr. Ironheart is being paid 80 million dollar a year. Such a heavy increase can be treated as an outlier and can contribute to a significant increase in the mean. This will not affect the median. Hence, Mr. Ironheart must be using Mean to show average payroll increase. On the other hand, employee union's president's metric shows only a 1 % increase in the average employee salary. This clearly means he is talking median as a heavy outlier will significantly increase the mean but not the median. In this case, I believe mean is the right measure of central tendency because addition of employees apart from CEO who have higher salaries cannot significantly increase the median but will definitely affect the median. Hence, Mr. Ironheart's claim makes more sense even though it is a bit heart breaking to hear ;)

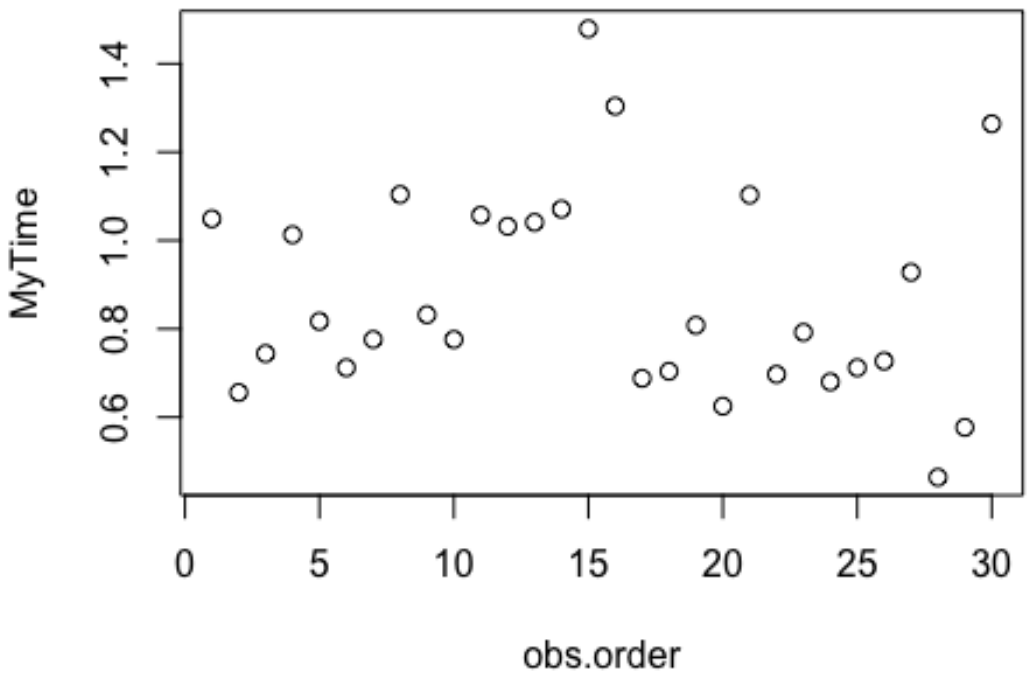
4) The claim looks incorrect for the following reasons:

a) Class of 1977 of Harvard may not be a good representative of all college students
b) Total number of dropouts is very much less than that of graduates. So, the data is imbalanced. We must use normalization to compare things here.

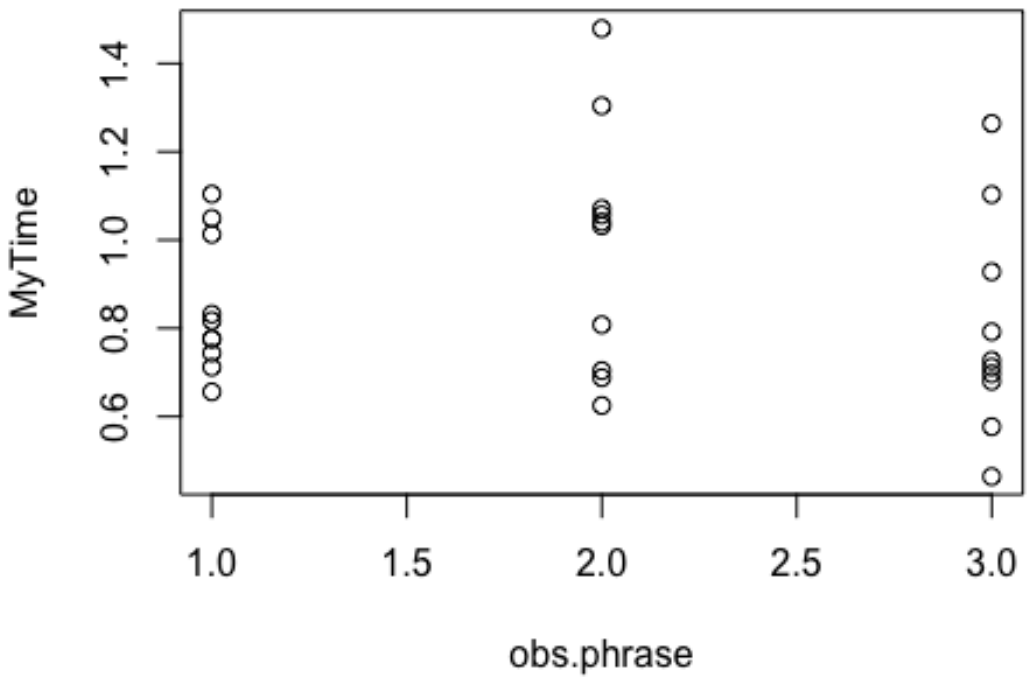
The reason why average wealth of dropouts is higher than that of graduates is more because they might have figured out their vision and pursued the entrepreneurial path while in college and so gave up on education. Mark Zuckerberg and Bill Gates are few relevant examples.

5)

```
MyTime <- scan(file = "CollectedResponseTimes.txt")
time.data <- data.frame(MyTime)
time.data$obs.order <- seq(length(time.data$MyTime))
time.data$obs.phrase <- ifelse(time.data$obs.order <= 10,
                               1,
                               ifelse(time.data$obs.order <= 20,
                                      2, 3))
# scatter plot of ResponseTime vs Observation Order
plot(MyTime ~ obs.order, data = time.data)
```




```
# Stratified scatter plot of 3 stages
plot(MyTime ~ obs.phrase, data = time.data)
```




```
summary(MyTime)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4640  0.7060  0.8000  0.8744  1.0470  1.4790

summary(MyTime[1:10])

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.6560  0.7520  0.7965  0.8479  0.9677  1.1040

summary(MyTime[11:20])

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.6250  0.7300  1.0365  0.9809  1.0675  1.4790

summary(MyTime[21:30])

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4640  0.6843  0.7195  0.7944  0.8940  1.2640
```

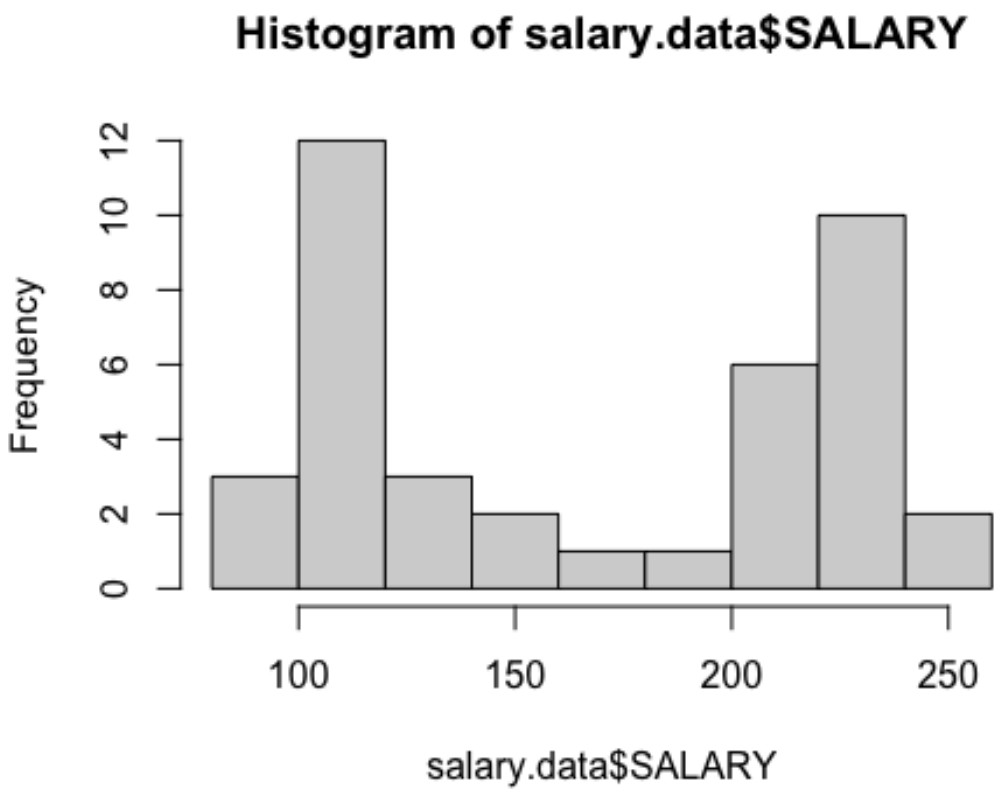
The difference in descriptive statistics for all 3 phrases indicate that the response time are not coming from a stationary process.

6)

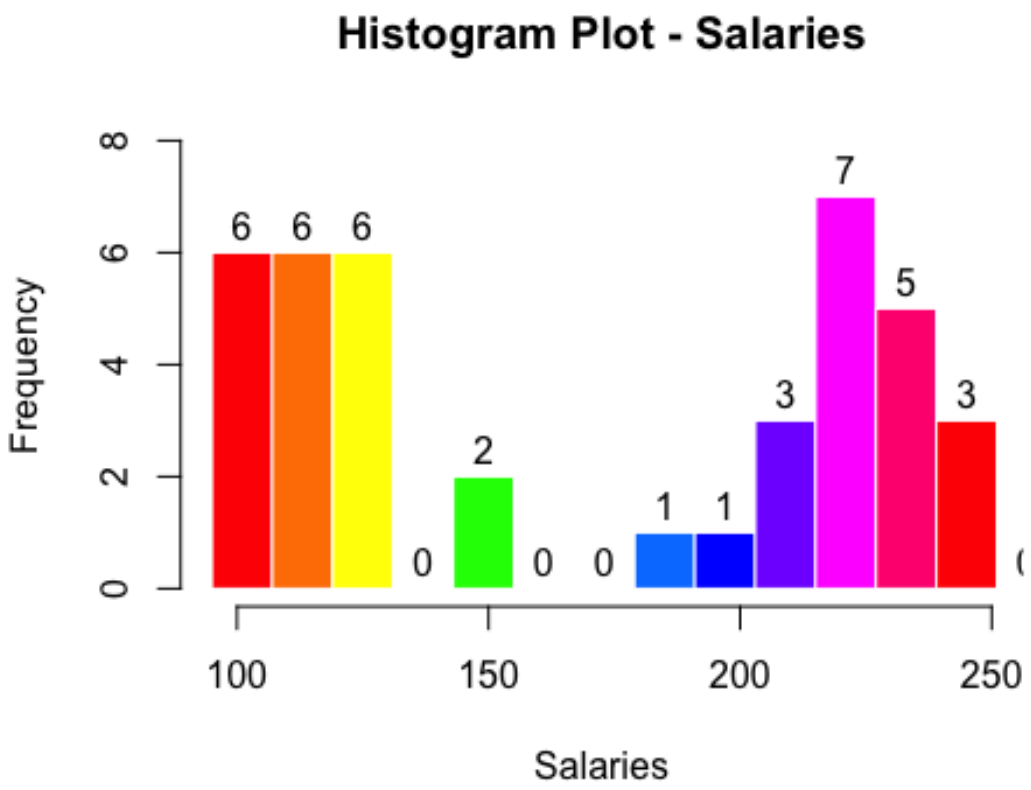
```
salary.data <- read.table(file="salary.txt", header=TRUE)
salary.data
```

```
##    GENDER SALARY
## 1       F    100
## 2       F     95
## 3       F    105
## 4       F    105
## 5       F    110
## 6       F     98
## 7       F    105
## 8       F    125
## 9       F    130
## 10      F    200
## 11      F    120
## 12      F    115
## 13      F    110
## 14      F    130
## 15      F    120
## 16      F    115
## 17      F    110
## 18      F    120
## 19      F    115
## 20      F    150
## 21      M    150
## 22      M    205
## 23      M    210
## 24      M    220
## 25      M    205
## 26      M    225
## 27      M    230
## 28      M    240
## 29      M    220
## 30      M    230
## 31      M    235
## 32      M    225
## 33      M    230
## 34      M    250
## 35      M    245
## 36      M    230
## 37      M    225
## 38      M    220
## 39      M    180
## 40      M    221
```

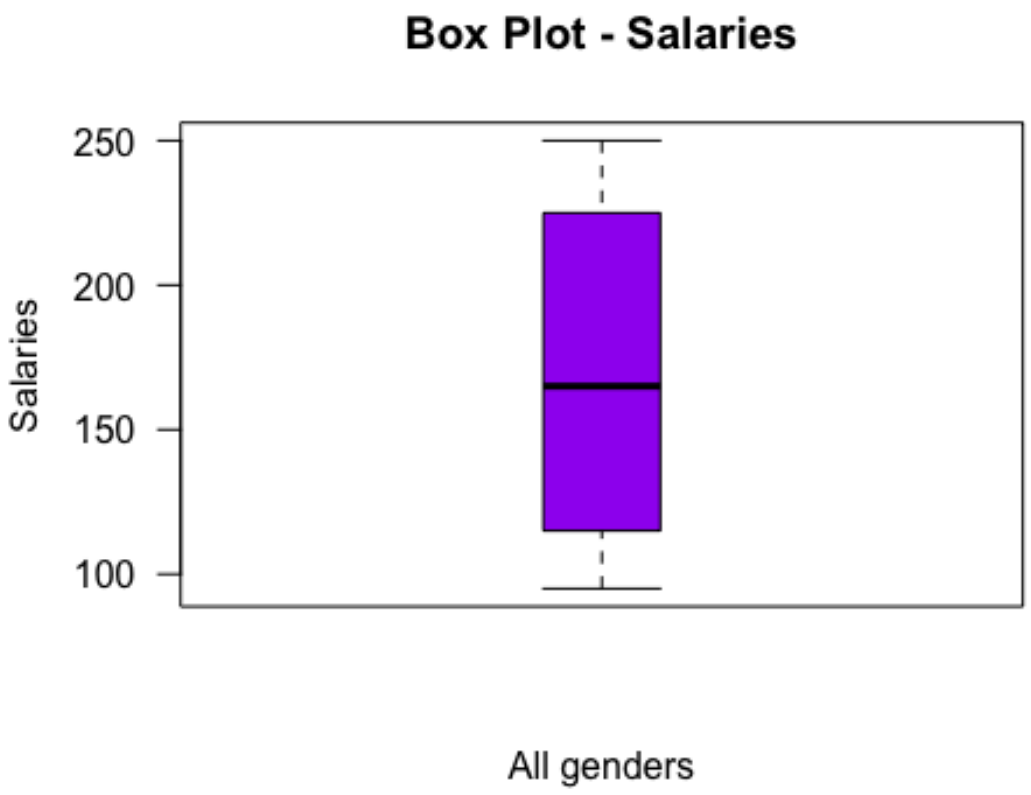
```
# a) Histogram of the salaries using R default setting
hist(salary.data$SALARY)
```




```r
# b) Histogram with break points (at least 15 intervals)
hist(salary.data$SALARY,
     breaks=95+(0:14)*12,
     main = "Histogram Plot - Salaries",
     xlab = "Salaries",
     ylab = "Frequency",
     border = FALSE,
     labels = TRUE,
     xlim = c(min(salary.data$SALARY), max(salary.data$SALARY)),
     ylim = c(0, 8),
     col = rainbow(12))
```




```
# c) Boxplot of the salaries
boxplot(salary.data$SALARY,
        main = "Box Plot - Salaries",
        xlab = "All genders",
        ylab = "Salaries",
        labels = TRUE,
        boxwex = 0.3,
        outline = TRUE,
        las = 1,
        notch = FALSE,
        staplewex = 1,
        col = "purple")
```




```r
# d) Boxplots of the salaries in two gender groups
boxplot(SALARY~GENDER, data=salary.data,
        main = "Box Plot - Salaries grouped by Gender",
        xlab = "Gender",
        ylab = "Salaries",
        labels = TRUE,
        boxwex = 0.3,
        outline = TRUE,
        outpch = 16,
        outcol = "seagreen3",
        las = 1,
        notch = FALSE,
        staplewex = 1,
        col = "tomato")

library(psych)
```


```
# e) summary statistics of salaries as one group and summary statistics withi
n each gender
describe(salary.data$SALARY)

##    vars  n   mean    sd median trimmed   mad min max range skew kurtosis
se
## X1    1 40 169.35 55.83    165  168.94 81.54  95 250   155 0.02    -1.83 8
.83

describeBy(salary.data$SALARY, salary.data$GENDER)

##
##  Descriptive statistics by group
## group: F
##    vars  n  mean    sd median trimmed   mad min max range skew kurtosis
se
## X1    1 20 118.9 23.01    115  114.69 14.83  95 200   105 2.16     5.03 5.
15
## ------------------------------------------------------------
## group: M
##    vars  n  mean    sd median trimmed  mad min max range  skew kurtosis
se
## X1    1 20 219.8 22.57    225  223.19 7.41 150 250   100 -1.53     2.37 5.
05
```

f) Looks like b) is a better representation of the histogram plot. Because we are getting even spread of data when the intervals are close to each other. Higher the number of intervals we get a better distribution of the data but with a greater complexity. Hence, the number of intervals has the chosen wisely. In this case, 15 intervals look like a better choice.

From the box plot grouped by gender, the weekly salaries for the women appear to be much lesser compared to that of men.

g) The central tendencies for example mean, median produced by describe and describe by groups appear to be far apart from each other. This clearly implies that we cannot summarize the center of the distribution of the salaries.

h) From the above box plots grouped by gender, we could see that women have two outliers located above the maximum whisker which is Q3 + 1.5 times the inter quartile range. Their values are 150, 200. Similarly, men have two outliers located below the minimum whisker which is Q1 - 1.5 times the inter quartile range. Their values are 180, 150.

7)

```
unicef.data <- read.table(file="unicef.txt", na.strings = ".", header=TRUE)
unicef.data
```

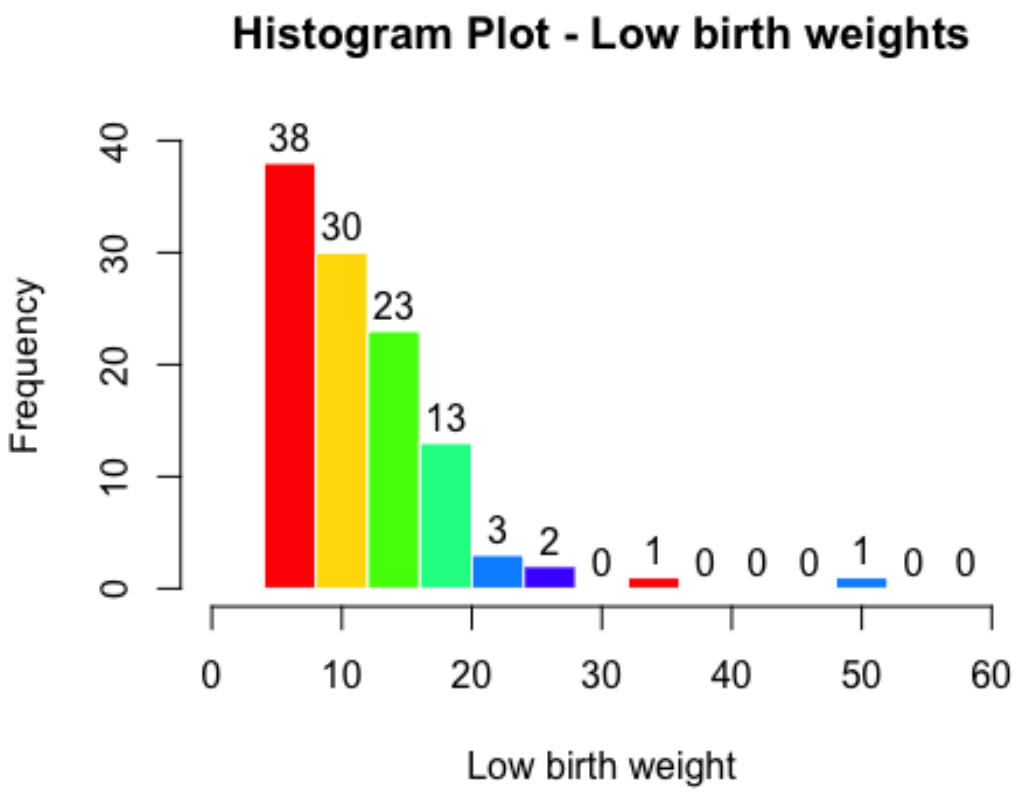
```
##                    nation lowbwt life60 life92
## 1             Afghanistan     20     33     43
## 2                 Albania      7     62     73
## 3                 Algeria      9     47     66
## 4                  Angola     19     33     46
## 5               Argentina      8     65     71
## 6                 Armenia     NA     NA     72
## 7               Australia      6     71     77
## 8                 Austria      6     69     76
## 9              Azerbaijan     NA     NA     71
## 10             Bangladesh     50     40     53
## 11                Belarus     NA     NA     71
## 12                Belgium      6     70     76
## 13                  Benin     NA     35     46
## 14                 Bhutan     NA     37     48
## 15                Bolivia     12     43     61
## 16               Botswana      8     46     61
## 17                 Brazil     11     55     66
```

```
## 18              Bulgaria      6     68     72
## 19          Burkina Faso     21     36     48
## 20               Burundi     NA     41     48
## 21              Cambodia     NA     42     51
## 22              Cameroon     13     39     56
## 23                Canada      6     71     77
## 24  Central African Rep.     15     39     47
## 25                  Chad     NA     35     47
## 26                 Chile      7     57     72
## 27                 China      9     47     71
## 28              Colombia     10     57     69
## 29                 Congo     16     42     52
## 30            Costa Rica      6     62     76
## 31         Cote d'Ivoire     14     39     52
## 32                  Cuba      8     64     76
## 33             Czech Rep.     NA     NA     72
## 34               Denmark      6     72     76
## 35        Dominican Rep.     16     52     67
## 36               Ecuador     11     53     66
## 37                 Egypt     10     46     61
## 38            El Salvador     11     50     66
## 39               Eritrea     NA     NA     47
## 40               Estonia     NA     69     71
## 41              Ethiopia     16     36     47
## 42               Finland      4     68     76
## 43                France      5     70     77
## 44                 Gabon     NA     41     53
## 45               Georgia     NA     NA     73
## 46               Germany     NA     70     76
## 47                 Ghana     17     45     56
## 48                Greece      6     69     77
## 49             Guatemala     14     46     64
## 50                Guinea     21     34     44
## 51         Guinea-Bissau     20     34     43
## 52                 Haiti     15     42     56
## 53              Honduras      9     46     66
## 54             Hong Kong      8     66     78
## 55               Hungary      9     68     70
## 56                 India     33     44     60
## 57             Indonesia     14     41     62
## 58                  Iran      9     50     67
## 59                  Iraq     15     48     66
## 60               Ireland      4     70     75
## 61                Israel      7     69     76
## 62                 Italy      5     69     77
## 63               Jamaica     11     63     73
## 64                 Japan      6     68     79
## 65                Jordan      7     47     68
## 66            Kazakhstan     NA     NA     69
## 67                 Kenya     16     45     59
```

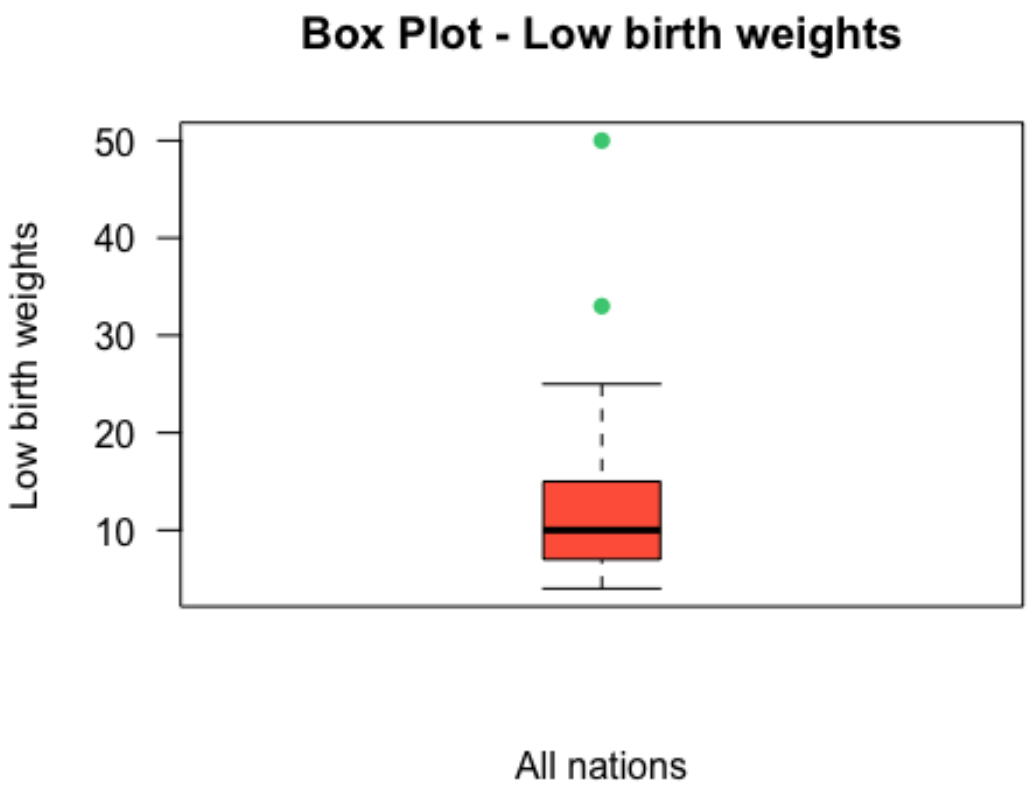
```
## 68           Korea, Dem.     NA     54     71
## 69           Korea, Rep.      9     54     71
## 70                Kuwait      7     60     75
## 71            Kyrgyzstan     NA     NA     66
## 72               Lao PDR     18     40     51
## 73                Latvia     NA     70     71
## 74               Lebanon     10     60     68
## 75               Lesotho     11     43     60
## 76               Liberia     NA     41     55
## 77     Libyan Arab Jama.     NA     47     63
## 78             Lithuania     NA     69     73
## 79            Madagascar     10     41     55
## 80                Malawi     20     38     44
## 81              Malaysia     10     54     71
## 82                  Mali     17     35     46
## 83            Mauritania     11     35     48
## 84             Mauritius      9     59     70
## 85                Mexico     12     57     70
## 86               Moldova     NA     NA     68
## 87              Mongolia     10     47     63
## 88               Morocco      9     47     63
## 89            Mozambique     20     37     47
## 90               Myanmar     16     44     57
## 91               Namibia     12     42     59
## 92                 Nepal     NA     38     53
## 93           Netherlands     NA     73     77
## 94           New Zealand      6     71     76
## 95             Nicaragua     15     47     66
## 96                 Niger     15     35     46
## 97               Nigeria     16     40     52
## 98                Norway      4     73     77
## 99                  Oman     10     40     69
## 100             Pakistan     25     43     59
## 101               Panama     10     61     73
## 102     Papua New Guinea     23     41     56
## 103              Paraguay      8     64     67
## 104                  Peru     11     48     64
## 105          Philippines     15     53     65
## 106               Poland     NA     67     72
## 107             Portugal      5     63     75
## 108              Romania      7     65     70
## 109         Russian Fed.     NA     NA     69
## 110               Rwanda     17     42     46
## 111         Saudi Arabia      7     44     69
## 112              Senegal     11     37     49
## 113         Sierra Leone     17     32     43
## 114            Singapore      7     64     74
## 115             Slovakia     NA     NA     72
## 116              Somalia     16     36     47
## 117         South Africa     NA     49     63
```

```
## 118                Spain      4     69     77
## 119            Sri Lanka     25     62     71
## 120                Sudan     15     39     52
## 121               Sweden      5     73     78
## 122          Switzerland      5     71     78
## 123     Syrian Arab Rep.     11     50     67
## 124             Tanzania     14     41     51
## 125             Thailand     13     52     69
## 126                 Togo     20     39     55
## 127  Trinidad and Tobago     10     63     71
## 128              Tunisia      8     48     68
## 129               Turkey      8     50     67
## 130         Turkmenistan     NA     NA     66
## 131                  USA      7     70     76
## 132               Uganda     NA     43     42
## 133              Ukraine     NA     NA     70
## 134 United Arab Emirates      7     53     71
## 135       United Kingdom      7     71     76
## 136              Uruguay      8     68     72
## 137           Uzbekistan     NA     NA     69
## 138            Venezuela      9     60     70
## 139             Viet Nam     17     44     64
## 140                Yemen     19     36     52
## 141  Yugoslavia (former)     NA     63     72
## 142                Zaire     15     41     52
## 143               Zambia     13     42     45
## 144             Zimbabwe     14     45     56
```

```r
# (a) Histogram and boxplot of low birth weight
hist(unicef.data$lowbwt,
     breaks=4+(0:14)*4,
     main = "Histogram Plot - Low birth weights",
     xlab = "Low birth weight",
     ylab = "Frequency",
     border = FALSE,
     labels = TRUE,
     xlim = c(0, 60),
     ylim = c(0, 40),
     col = rainbow(7))
```




```
boxplot(unicef.data$lowbwt,
        main = "Box Plot - Low birth weights",
        xlab = "All nations",
        ylab = "Low birth weights",
        labels = TRUE,
        boxwex = 0.3,
        outline = TRUE,
        outpch = 16,
        outcol = "seagreen3",
        las = 1,
        notch = FALSE,
        staplewex = 1,
        col = "tomato")
```



b) The histogram plot clearly shows that the data is right skewed as the tail is elongated toward the right.

c) The box plot shows that two values lie above maximum whisker, which is Q3 + 1.5 times interquartile range. The values are 50, 33.