Solution Paper 3

2022-04-22

```
##Q1
#A
mean = 4
variance = 8
##(a)
lambda = mean / variance
alpha = mean*lambda
set.seed(12)
sim.y = rgamma(100,alpha,lambda)
mean(sim.y)
```

```
## [1] 4.033375
```

```
median(sim.y)
```

```
## [1] 3.485327
```

```
f = density(sim.y)
mode.y = f$x[which.max(f$y)]
mode.y
```

```
## [1] 2.252472
```

```
##(b)
pop.mean = alpha/lambda
pop.median = qgamma(0.5,alpha,lambda)
pop.mode = (alpha - 1)/lambda
pop.mean;mean(sim.y)
```

```
## [1] 4
```

```
## [1] 4.033375
```

```
pop.median;median(sim.y)
```

```
## [1] 3.356694
```

```
## [1] 3.485327
```

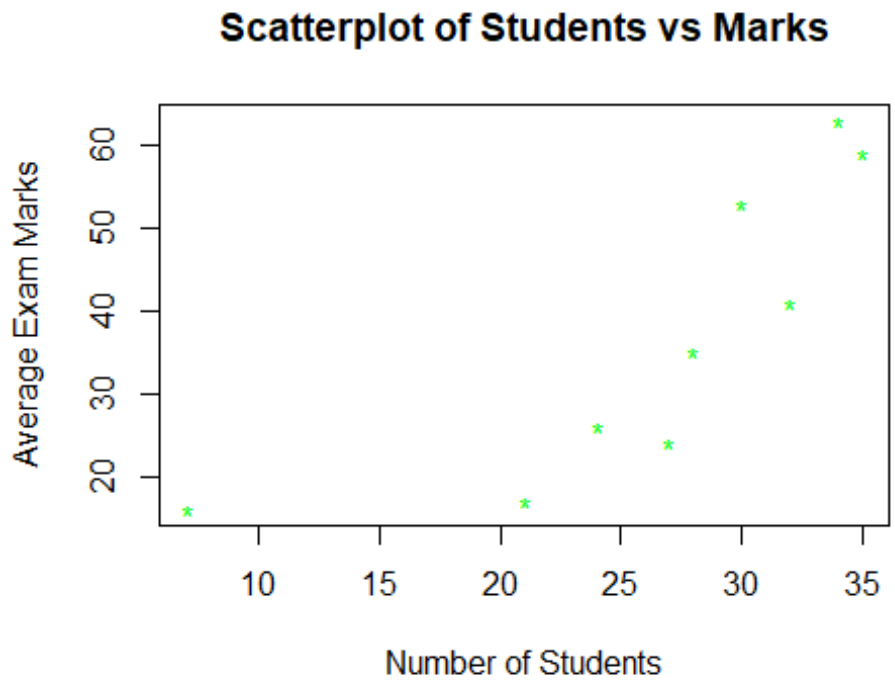
```
pop.mode;mode.y
```

```
## [1] 2
```

```
## [1] 2.252472
```

```
#All the population moments are quite near to the sample / empirical moments.
```

```r
##Q1B
n = c(35,32,27,21,34,30,28,24,7)
m = c(59,41,24,17,63,53,35,26,16)
##(a)
plot(n,m,
     col = "green",
     pch = "*",
     main = "Scatterplot of Students vs Marks",
     xlab = "Number of Students",
     ylab = "Average Exam Marks")
```




```r
#The two variables seem to have a positive correlation.
#The relationship seems to be linear in nature expect when number of students
is very low.
##(b)
cor.test(n,m, alternative = "greater")

##
##  Pearson's product-moment correlation
##
## data:  n and m
## t = 3.6603, df = 7, p-value = 0.004033
## alternative hypothesis: true correlation is greater than 0
## 95 percent confidence interval:
##  0.4274953 1.0000000
## sample estimates:
```

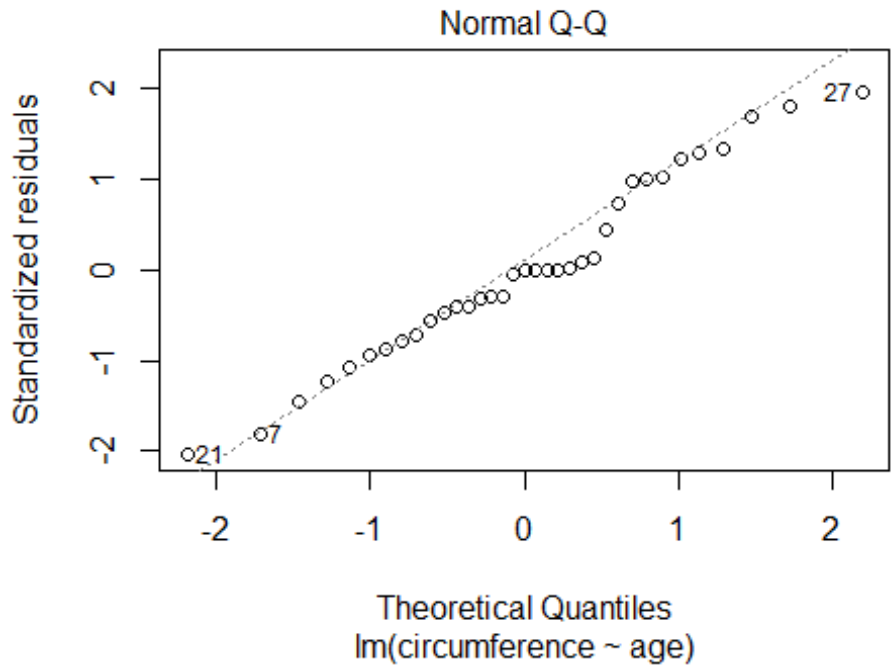
```
##       cor
## 0.8104492

#Since the above 95% Confidence Interval contains 0.8 , we can say we have
sufficient evidence to accept the H0, i.e. rho = 0.8

##Q1C
##(i)
lm1 = lm(circumference~age, data = Orange)
##(ii)
summary(lm1)$sigma

## [1] 23.73767

##(iii)
plot(lm1,2)
```



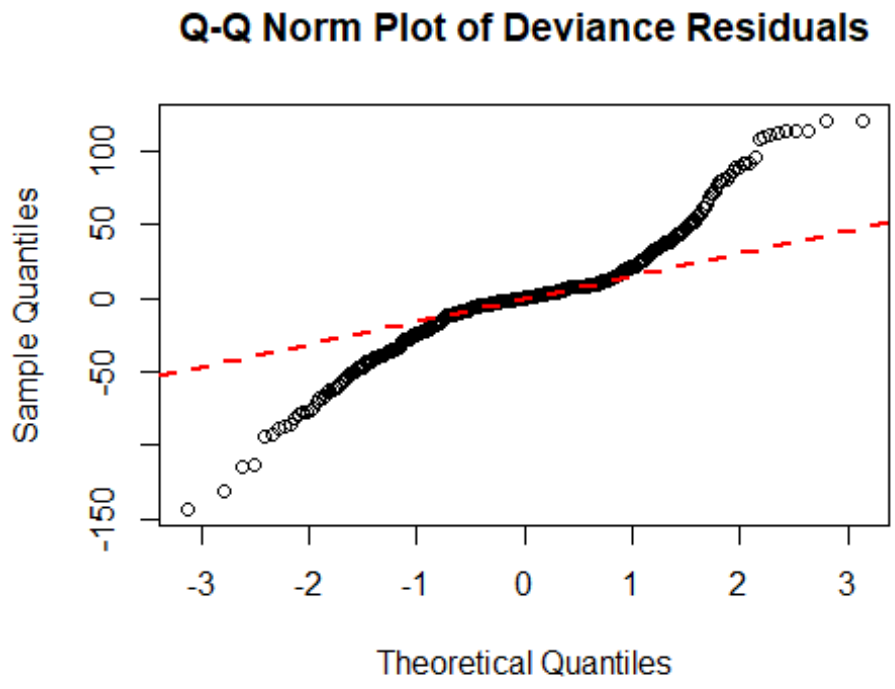

```
#Overall, the points seems to lie on the Normal Line
#At Around the median, there is a difference between the theoretical and
sample quantiles.
#Overall, we would suggest that errors follow a Normal Distribution by
looking at this graph

##Q2A
set.seed(1729)
n = 100
wait.times = -log(runif(n))/0.1
```

```r
##(i)
set.seed(2022)
boot.median = replicate(1000,
                        median(rexp(n,1/mean(wait.times))))
##(ii)
alpha = 0.03
quantile(boot.median,c(alpha/2,1-alpha/2))
```

```
##     1.5%    98.5%
## 5.258064 9.675926
```

```r
##Q2B
glm = glm(weight~Time + I(Time^2) + Diet,
          data = ChickWeight,
          family = gaussian(link = "log"))
##(a)
##If the student does plot(glm,2) , please award 0.5 marks in this subpart
deviance.resid = resid(glm,type = "deviance")
qqnorm(deviance.resid,
       main = "Q-Q Norm Plot of Deviance Residuals")
qqline(deviance.resid,col = "red", lty = 2, lwd = 2)
```




```r
#The Points in the tails (both ends) are quite far off the red line. We can
say while deviance residuals are symettric , they are not normal.
##(b)
new.data = data.frame(Time = 12, Diet = "3")
predict(glm,new.data, type = "response")
```

```
##        1
## 150.0973
```

```
##Q2C
Males <- c(21,22,28,27,20,23,26,32,25,21,30)
Females <- c(19,18,38,33,24,39,22,29,28,26,30)
##(a)
test = var.test(Males,Females)
test$alternative
```

```
## [1] "two.sided"
```

```
test$p.value
```

```
## [1] 0.0898616
```

```
##(b)
#Since the p - value of the test (0.089) which is greater than 5% , we can
conclude that the variances are equal.
#Since the two sample t - test requires that the population variances are
equal , which is true here.

##Q3A
sachin = c(12,35,65,125,118,48,28,48)
lara = c(75,08,28,107,137,45,36,60)
##(a)
t.test(sachin,lara,
       paired = TRUE)
```

```
##
##  Paired t-test
##
## data:  sachin and lara
## t = -0.19098, df = 7, p-value = 0.854
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -28.43524  24.18524
## sample estimates:
## mean of the differences
##                  -2.125
```

```
#Since p - values are greater than 5% , we can conclude that the means are
equal.
##(b)
var.test(sachin,lara,conf.level = 0.99)$conf.int
```

```
## [1] 0.103748 8.190916
## attr(,"conf.level")
## [1] 0.99
```

```
##(c)
D = sachin - lara
```

```r
ObsT = median(D)
##(d)
sign = c(-1,1)
##(e)
library("gtools")
p = permutations(2,8,c(-1,1),repeats.allowed = T)
p
```

```
##        [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8]
##   [1,]   -1   -1   -1   -1   -1   -1   -1   -1
##   [2,]   -1   -1   -1   -1   -1   -1   -1    1
##   [3,]   -1   -1   -1   -1   -1   -1    1   -1
##   [4,]   -1   -1   -1   -1   -1   -1    1    1
##   [5,]   -1   -1   -1   -1   -1    1   -1   -1
##   [6,]   -1   -1   -1   -1   -1    1   -1    1
##   [7,]   -1   -1   -1   -1   -1    1    1   -1
##   [8,]   -1   -1   -1   -1   -1    1    1    1
##   [9,]   -1   -1   -1   -1    1   -1   -1   -1
##  [10,]   -1   -1   -1   -1    1   -1   -1    1
##  [11,]   -1   -1   -1   -1    1   -1    1   -1
##  [12,]   -1   -1   -1   -1    1   -1    1    1
##  [13,]   -1   -1   -1   -1    1    1   -1   -1
##  [14,]   -1   -1   -1   -1    1    1   -1    1
##  [15,]   -1   -1   -1   -1    1    1    1   -1
##  [16,]   -1   -1   -1   -1    1    1    1    1
##  [17,]   -1   -1   -1    1   -1   -1   -1   -1
##  [18,]   -1   -1   -1    1   -1   -1   -1    1
##  [19,]   -1   -1   -1    1   -1   -1    1   -1
##  [20,]   -1   -1   -1    1   -1   -1    1    1
##  [21,]   -1   -1   -1    1   -1    1   -1   -1
##  [22,]   -1   -1   -1    1   -1    1   -1    1
##  [23,]   -1   -1   -1    1   -1    1    1   -1
##  [24,]   -1   -1   -1    1   -1    1    1    1
##  [25,]   -1   -1   -1    1    1   -1   -1   -1
##  [26,]   -1   -1   -1    1    1   -1   -1    1
##  [27,]   -1   -1   -1    1    1   -1    1   -1
##  [28,]   -1   -1   -1    1    1   -1    1    1
##  [29,]   -1   -1   -1    1    1    1   -1   -1
##  [30,]   -1   -1   -1    1    1    1   -1    1
##  [31,]   -1   -1   -1    1    1    1    1   -1
##  [32,]   -1   -1   -1    1    1    1    1    1
##  [33,]   -1   -1    1   -1   -1   -1   -1   -1
##  [34,]   -1   -1    1   -1   -1   -1   -1    1
##  [35,]   -1   -1    1   -1   -1   -1    1   -1
##  [36,]   -1   -1    1   -1   -1   -1    1    1
##  [37,]   -1   -1    1   -1   -1    1   -1   -1
##  [38,]   -1   -1    1   -1   -1    1   -1    1
##  [39,]   -1   -1    1   -1   -1    1    1   -1
##  [40,]   -1   -1    1   -1   -1    1    1    1
##  [41,]   -1   -1    1   -1    1   -1   -1   -1
```

```
##  [42,]   -1   -1    1   -1    1   -1   -1    1
##  [43,]   -1   -1    1   -1    1   -1    1   -1
##  [44,]   -1   -1    1   -1    1   -1    1    1
##  [45,]   -1   -1    1   -1    1    1   -1   -1
##  [46,]   -1   -1    1   -1    1    1   -1    1
##  [47,]   -1   -1    1   -1    1    1    1   -1
##  [48,]   -1   -1    1   -1    1    1    1    1
##  [49,]   -1   -1    1    1   -1   -1   -1   -1
##  [50,]   -1   -1    1    1   -1   -1   -1    1
##  [51,]   -1   -1    1    1   -1   -1    1   -1
##  [52,]   -1   -1    1    1   -1   -1    1    1
##  [53,]   -1   -1    1    1   -1    1   -1   -1
##  [54,]   -1   -1    1    1   -1    1   -1    1
##  [55,]   -1   -1    1    1   -1    1    1   -1
##  [56,]   -1   -1    1    1   -1    1    1    1
##  [57,]   -1   -1    1    1    1   -1   -1   -1
##  [58,]   -1   -1    1    1    1   -1   -1    1
##  [59,]   -1   -1    1    1    1   -1    1   -1
##  [60,]   -1   -1    1    1    1   -1    1    1
##  [61,]   -1   -1    1    1    1    1   -1   -1
##  [62,]   -1   -1    1    1    1    1   -1    1
##  [63,]   -1   -1    1    1    1    1    1   -1
##  [64,]   -1   -1    1    1    1    1    1    1
##  [65,]   -1    1   -1   -1   -1   -1   -1   -1
##  [66,]   -1    1   -1   -1   -1   -1   -1    1
##  [67,]   -1    1   -1   -1   -1   -1    1   -1
##  [68,]   -1    1   -1   -1   -1   -1    1    1
##  [69,]   -1    1   -1   -1   -1    1   -1   -1
##  [70,]   -1    1   -1   -1   -1    1   -1    1
##  [71,]   -1    1   -1   -1   -1    1    1   -1
##  [72,]   -1    1   -1   -1   -1    1    1    1
##  [73,]   -1    1   -1   -1    1   -1   -1   -1
##  [74,]   -1    1   -1   -1    1   -1   -1    1
##  [75,]   -1    1   -1   -1    1   -1    1   -1
##  [76,]   -1    1   -1   -1    1   -1    1    1
##  [77,]   -1    1   -1   -1    1    1   -1   -1
##  [78,]   -1    1   -1   -1    1    1   -1    1
##  [79,]   -1    1   -1   -1    1    1    1   -1
##  [80,]   -1    1   -1   -1    1    1    1    1
##  [81,]   -1    1   -1    1   -1   -1   -1   -1
##  [82,]   -1    1   -1    1   -1   -1   -1    1
##  [83,]   -1    1   -1    1   -1   -1    1   -1
##  [84,]   -1    1   -1    1   -1   -1    1    1
##  [85,]   -1    1   -1    1   -1    1   -1   -1
##  [86,]   -1    1   -1    1   -1    1   -1    1
##  [87,]   -1    1   -1    1   -1    1    1   -1
##  [88,]   -1    1   -1    1   -1    1    1    1
##  [89,]   -1    1   -1    1    1   -1   -1   -1
##  [90,]   -1    1   -1    1    1   -1   -1    1
##  [91,]   -1    1   -1    1    1   -1    1   -1
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##  [92,]   -1    1   -1    1    1   -1    1    1
##  [93,]   -1    1   -1    1    1    1   -1   -1
##  [94,]   -1    1   -1    1    1    1   -1    1
##  [95,]   -1    1   -1    1    1    1    1   -1
##  [96,]   -1    1   -1    1    1    1    1    1
##  [97,]   -1    1    1   -1   -1   -1   -1   -1
##  [98,]   -1    1    1   -1   -1   -1   -1    1
##  [99,]   -1    1    1   -1   -1   -1    1   -1
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## [101,]   -1    1    1   -1   -1    1   -1   -1
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## [106,]   -1    1    1   -1    1   -1   -1    1
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## [113,]   -1    1    1    1   -1   -1   -1   -1
## [114,]   -1    1    1    1   -1   -1   -1    1
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## [126,]   -1    1    1    1    1    1   -1    1
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## [131,]    1   -1   -1   -1   -1   -1    1   -1
## [132,]    1   -1   -1   -1   -1   -1    1    1
## [133,]    1   -1   -1   -1   -1    1   -1   -1
## [134,]    1   -1   -1   -1   -1    1   -1    1
## [135,]    1   -1   -1   -1   -1    1    1   -1
## [136,]    1   -1   -1   -1   -1    1    1    1
## [137,]    1   -1   -1   -1    1   -1   -1   -1
## [138,]    1   -1   -1   -1    1   -1   -1    1
## [139,]    1   -1   -1   -1    1   -1    1   -1
## [140,]    1   -1   -1   -1    1   -1    1    1
## [141,]    1   -1   -1   -1    1    1   -1   -1
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## [142,]    1   -1   -1   -1    1    1   -1    1
## [143,]    1   -1   -1   -1    1    1    1   -1
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## [145,]    1   -1   -1    1   -1   -1   -1   -1
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## [148,]    1   -1   -1    1   -1   -1    1    1
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## [150,]    1   -1   -1    1   -1    1   -1    1
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## [154,]    1   -1   -1    1    1   -1   -1    1
## [155,]    1   -1   -1    1    1   -1    1   -1
## [156,]    1   -1   -1    1    1   -1    1    1
## [157,]    1   -1   -1    1    1    1   -1   -1
## [158,]    1   -1   -1    1    1    1   -1    1
## [159,]    1   -1   -1    1    1    1    1   -1
## [160,]    1   -1   -1    1    1    1    1    1
## [161,]    1   -1    1   -1   -1   -1   -1   -1
## [162,]    1   -1    1   -1   -1   -1   -1    1
## [163,]    1   -1    1   -1   -1   -1    1   -1
## [164,]    1   -1    1   -1   -1   -1    1    1
## [165,]    1   -1    1   -1   -1    1   -1   -1
## [166,]    1   -1    1   -1   -1    1   -1    1
## [167,]    1   -1    1   -1   -1    1    1   -1
## [168,]    1   -1    1   -1   -1    1    1    1
## [169,]    1   -1    1   -1    1   -1   -1   -1
## [170,]    1   -1    1   -1    1   -1   -1    1
## [171,]    1   -1    1   -1    1   -1    1   -1
## [172,]    1   -1    1   -1    1   -1    1    1
## [173,]    1   -1    1   -1    1    1   -1   -1
## [174,]    1   -1    1   -1    1    1   -1    1
## [175,]    1   -1    1   -1    1    1    1   -1
## [176,]    1   -1    1   -1    1    1    1    1
## [177,]    1   -1    1    1   -1   -1   -1   -1
## [178,]    1   -1    1    1   -1   -1   -1    1
## [179,]    1   -1    1    1   -1   -1    1   -1
## [180,]    1   -1    1    1   -1   -1    1    1
## [181,]    1   -1    1    1   -1    1   -1   -1
## [182,]    1   -1    1    1   -1    1   -1    1
## [183,]    1   -1    1    1   -1    1    1   -1
## [184,]    1   -1    1    1   -1    1    1    1
## [185,]    1   -1    1    1    1   -1   -1   -1
## [186,]    1   -1    1    1    1   -1   -1    1
## [187,]    1   -1    1    1    1   -1    1   -1
## [188,]    1   -1    1    1    1   -1    1    1
## [189,]    1   -1    1    1    1    1   -1   -1
## [190,]    1   -1    1    1    1    1   -1    1
## [191,]    1   -1    1    1    1    1    1   -1
```
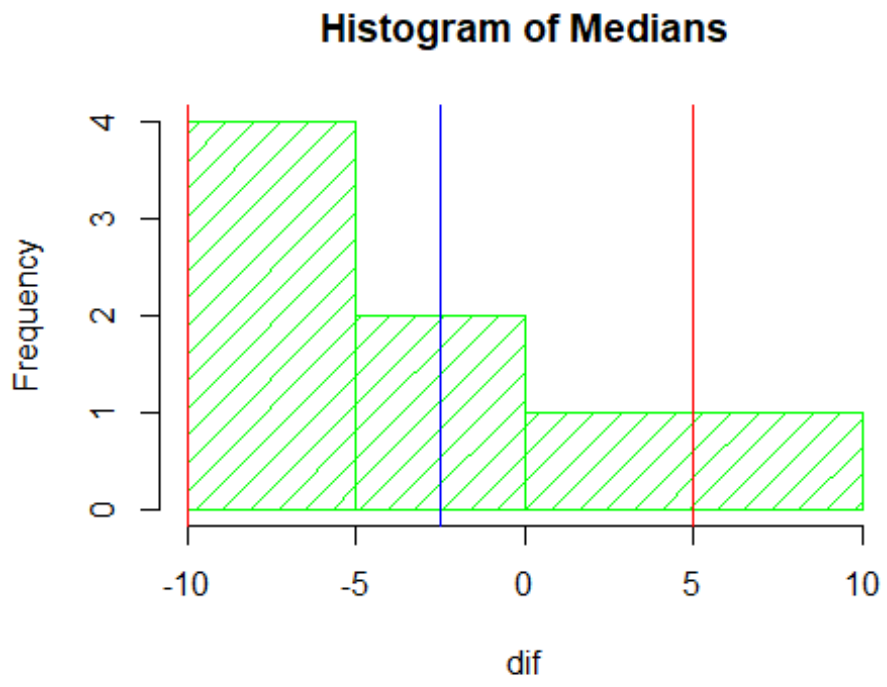
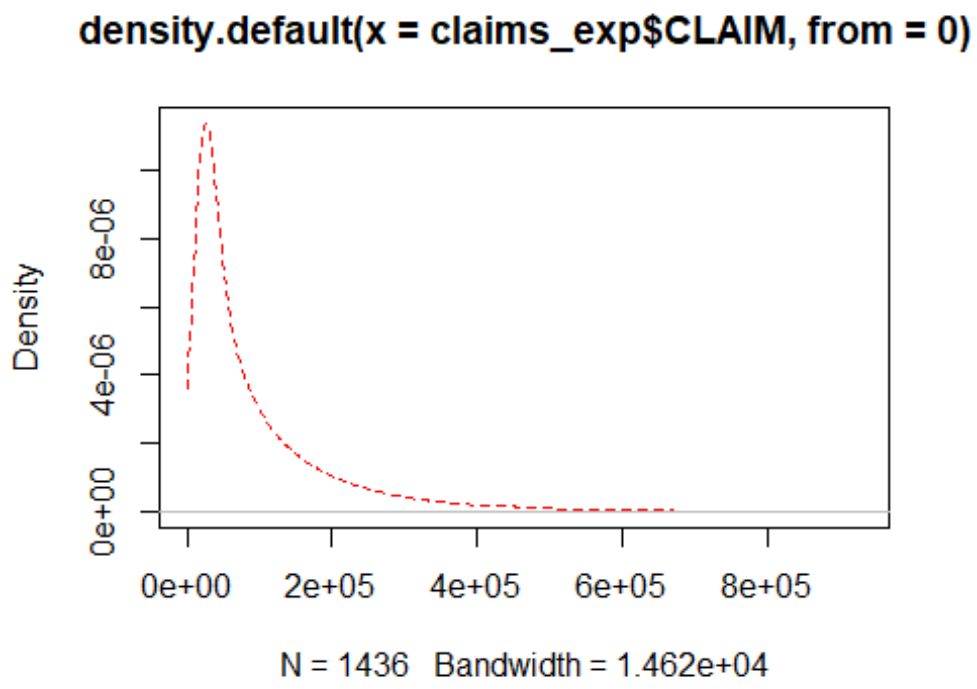

```
## [192,]    1   -1    1    1    1    1    1    1
## [193,]    1    1   -1   -1   -1   -1   -1   -1
## [194,]    1    1   -1   -1   -1   -1   -1    1
## [195,]    1    1   -1   -1   -1   -1    1   -1
## [196,]    1    1   -1   -1   -1   -1    1    1
## [197,]    1    1   -1   -1   -1    1   -1   -1
## [198,]    1    1   -1   -1   -1    1   -1    1
## [199,]    1    1   -1   -1   -1    1    1   -1
## [200,]    1    1   -1   -1   -1    1    1    1
## [201,]    1    1   -1   -1    1   -1   -1   -1
## [202,]    1    1   -1   -1    1   -1   -1    1
## [203,]    1    1   -1   -1    1   -1    1   -1
## [204,]    1    1   -1   -1    1   -1    1    1
## [205,]    1    1   -1   -1    1    1   -1   -1
## [206,]    1    1   -1   -1    1    1   -1    1
## [207,]    1    1   -1   -1    1    1    1   -1
## [208,]    1    1   -1   -1    1    1    1    1
## [209,]    1    1   -1    1   -1   -1   -1   -1
## [210,]    1    1   -1    1   -1   -1   -1    1
## [211,]    1    1   -1    1   -1   -1    1   -1
## [212,]    1    1   -1    1   -1   -1    1    1
## [213,]    1    1   -1    1   -1    1   -1   -1
## [214,]    1    1   -1    1   -1    1   -1    1
## [215,]    1    1   -1    1   -1    1    1   -1
## [216,]    1    1   -1    1   -1    1    1    1
## [217,]    1    1   -1    1    1   -1   -1   -1
## [218,]    1    1   -1    1    1   -1   -1    1
## [219,]    1    1   -1    1    1   -1    1   -1
## [220,]    1    1   -1    1    1   -1    1    1
## [221,]    1    1   -1    1    1    1   -1   -1
## [222,]    1    1   -1    1    1    1   -1    1
## [223,]    1    1   -1    1    1    1    1   -1
## [224,]    1    1   -1    1    1    1    1    1
## [225,]    1    1    1   -1   -1   -1   -1   -1
## [226,]    1    1    1   -1   -1   -1   -1    1
## [227,]    1    1    1   -1   -1   -1    1   -1
## [228,]    1    1    1   -1   -1   -1    1    1
## [229,]    1    1    1   -1   -1    1   -1   -1
## [230,]    1    1    1   -1   -1    1   -1    1
## [231,]    1    1    1   -1   -1    1    1   -1
## [232,]    1    1    1   -1   -1    1    1    1
## [233,]    1    1    1   -1    1   -1   -1   -1
## [234,]    1    1    1   -1    1   -1   -1    1
## [235,]    1    1    1   -1    1   -1    1   -1
## [236,]    1    1    1   -1    1   -1    1    1
## [237,]    1    1    1   -1    1    1   -1   -1
## [238,]    1    1    1   -1    1    1   -1    1
## [239,]    1    1    1   -1    1    1    1   -1
## [240,]    1    1    1   -1    1    1    1    1
## [241,]    1    1    1    1   -1   -1   -1   -1
```

```
## [242,]    1    1    1    1   -1   -1   -1    1
## [243,]    1    1    1    1   -1   -1    1   -1
## [244,]    1    1    1    1   -1   -1    1    1
## [245,]    1    1    1    1   -1    1   -1   -1
## [246,]    1    1    1    1   -1    1   -1    1
## [247,]    1    1    1    1   -1    1    1   -1
## [248,]    1    1    1    1   -1    1    1    1
## [249,]    1    1    1    1    1   -1   -1   -1
## [250,]    1    1    1    1    1   -1   -1    1
## [251,]    1    1    1    1    1   -1    1   -1
## [252,]    1    1    1    1    1   -1    1    1
## [253,]    1    1    1    1    1    1   -1   -1
## [254,]    1    1    1    1    1    1   -1    1
## [255,]    1    1    1    1    1    1    1   -1
## [256,]    1    1    1    1    1    1    1    1
```

```r
##(f)
n = ncol(p)
dif = rep(0,n)
for(i in 1:n){
  dif[i] = median(D*p[i,])
}
##(g)
hist(dif,
     main = "Histogram of Medians",
     col = "green",
     density = 10)
abline(v = quantile(dif,0.025), col = "red")
abline(v = quantile(dif,0.975), col = "red")
abline(v = ObsT,col = "blue")
```




```
#Since the observed value is in between the Critical values, we can conclude
that the medians are equal.

##Q3B
#(a)
claims_exp = read.csv("Claims_Experience.csv")
nrow(claims_exp)

## [1] 1436

#(b)
plot(density(claims_exp$CLAIM, from = 0), col = "red", lty = 2)
```




```
#It is clear that CLAIM is +vely skewed. We can use the Log Normal
Distribution or Gamma Distribution.
#(c)
model1 = glm(CLAIM~LOCATION*JOB*SEX*AGE,
             data = claims_exp,
             family = Gamma(link = "inverse"))
model1$coefficients
```

```
##                                (Intercept)
##                               6.648743e-05
##                          LOCATIONREGION 02
##                               6.082008e-06
##                          LOCATIONREGION 03
##                              -7.057874e-06
##                          LOCATIONREGION 04
##                               2.053610e-06
##                          LOCATIONREGION 05
##                              -1.279087e-06
##                          LOCATIONREGION 06
##                              -1.079271e-05
##                          LOCATIONREGION 07
##                              -6.219876e-06
##                          LOCATIONREGION 08
##                               3.112934e-05
##                          LOCATIONREGION 09
##                              -4.394827e-06
```

```
##                            LOCATIONREGION 10
##                                 2.248405e-05
##                            LOCATIONREGION 11
##                                 5.214718e-06
##                                  JOBBusiness
##                                -8.473181e-05
##                              JOBSelfemployed
##                                -1.506208e-05
##                                   JOBService
##                                -5.487268e-05
##                                          SEXM
##                                 7.394354e-06
##                                          AGE
##                                -9.615268e-07
##              LOCATIONREGION 02:JOBBusiness
##                                 2.190482e-05
##              LOCATIONREGION 03:JOBBusiness
##                                 1.487980e-04
##              LOCATIONREGION 04:JOBBusiness
##                                -1.784083e-05
##              LOCATIONREGION 05:JOBBusiness
##                                 3.934269e-05
##              LOCATIONREGION 06:JOBBusiness
##                                 4.447039e-06
##              LOCATIONREGION 07:JOBBusiness
##                                           NA
##              LOCATIONREGION 08:JOBBusiness
##                                 1.253765e-05
##              LOCATIONREGION 09:JOBBusiness
##                                -3.945155e-06
##              LOCATIONREGION 10:JOBBusiness
##                                -1.803709e-06
##              LOCATIONREGION 11:JOBBusiness
##                                           NA
##           LOCATIONREGION 02:JOBSelfemployed
##                                -9.160112e-06
##           LOCATIONREGION 03:JOBSelfemployed
##                                -8.981197e-06
##           LOCATIONREGION 04:JOBSelfemployed
##                                -2.233671e-05
##           LOCATIONREGION 05:JOBSelfemployed
##                                -1.348598e-05
##           LOCATIONREGION 06:JOBSelfemployed
##                                -8.590919e-06
##           LOCATIONREGION 07:JOBSelfemployed
##                                -1.591509e-05
##           LOCATIONREGION 08:JOBSelfemployed
##                                -2.379111e-05
##           LOCATIONREGION 09:JOBSelfemployed
##                                 6.703445e-07
```

```
##          LOCATIONREGION 10:JOBSelfemployed
##                                -4.611627e-05
##          LOCATIONREGION 11:JOBSelfemployed
##                                -2.430463e-05
##               LOCATIONREGION 02:JOBService
##                                -2.107660e-05
##               LOCATIONREGION 03:JOBService
##                                -1.997418e-06
##               LOCATIONREGION 04:JOBService
##                                -2.824428e-05
##               LOCATIONREGION 05:JOBService
##                                -4.380992e-05
##               LOCATIONREGION 06:JOBService
##                                -1.495554e-05
##               LOCATIONREGION 07:JOBService
##                                          NA
##               LOCATIONREGION 08:JOBService
##                                -1.839124e-05
##               LOCATIONREGION 09:JOBService
##                                 5.542681e-06
##               LOCATIONREGION 10:JOBService
##                                -6.870395e-06
##               LOCATIONREGION 11:JOBService
##                                -2.540112e-06
##                     LOCATIONREGION 02:SEXM
##                                 8.127953e-06
##                     LOCATIONREGION 03:SEXM
##                                 8.904409e-07
##                     LOCATIONREGION 04:SEXM
##                                 1.005682e-05
##                     LOCATIONREGION 05:SEXM
##                                 8.190134e-06
##                     LOCATIONREGION 06:SEXM
##                                 9.653825e-06
##                     LOCATIONREGION 07:SEXM
##                                -1.411381e-05
##                     LOCATIONREGION 08:SEXM
##                                 8.774610e-06
##                     LOCATIONREGION 09:SEXM
##                                -1.552181e-06
##                     LOCATIONREGION 10:SEXM
##                                -2.426235e-06
##                     LOCATIONREGION 11:SEXM
##                                -2.214530e-05
##                           JOBBusiness:SEXM
##                                 8.130285e-06
##                       JOBSelfemployed:SEXM
##                                -6.226583e-06
##                            JOBService:SEXM
##                                -1.131110e-05
```

```
##                       LOCATIONREGION 02:AGE
##                              -1.433937e-07
##                       LOCATIONREGION 03:AGE
##                               1.529197e-07
##                       LOCATIONREGION 04:AGE
##                              -7.211924e-08
##                       LOCATIONREGION 05:AGE
##                               2.842271e-08
##                       LOCATIONREGION 06:AGE
##                               1.934835e-07
##                       LOCATIONREGION 07:AGE
##                               1.355919e-07
##                       LOCATIONREGION 08:AGE
##                              -5.660481e-07
##                       LOCATIONREGION 09:AGE
##                               1.242373e-07
##                       LOCATIONREGION 10:AGE
##                              -5.238387e-07
##                       LOCATIONREGION 11:AGE
##                              -3.955090e-08
##                            JOBBusiness:AGE
##                               1.296333e-06
##                         JOBSelfemployed:AGE
##                               2.072594e-07
##                             JOBService:AGE
##                               8.116343e-07
##                                  SEXM:AGE
##                              -1.212850e-07
##         LOCATIONREGION 02:JOBBusiness:SEXM
##                              -2.772917e-05
##         LOCATIONREGION 03:JOBBusiness:SEXM
##                              -1.377355e-04
##         LOCATIONREGION 04:JOBBusiness:SEXM
##                               1.170428e-06
##         LOCATIONREGION 05:JOBBusiness:SEXM
##                              -3.935562e-05
##         LOCATIONREGION 06:JOBBusiness:SEXM
##                                        NA
##         LOCATIONREGION 07:JOBBusiness:SEXM
##                                        NA
##         LOCATIONREGION 08:JOBBusiness:SEXM
##                              -8.176112e-06
##         LOCATIONREGION 09:JOBBusiness:SEXM
##                               4.081533e-06
##         LOCATIONREGION 10:JOBBusiness:SEXM
##                              -4.146076e-06
##         LOCATIONREGION 11:JOBBusiness:SEXM
##                                        NA
##     LOCATIONREGION 02:JOBSelfemployed:SEXM
##                              -6.313137e-06
```

```
##     LOCATIONREGION 03:JOBSelfemployed:SEXM
##                               7.129838e-07
##     LOCATIONREGION 04:JOBSelfemployed:SEXM
##                               3.451671e-06
##     LOCATIONREGION 05:JOBSelfemployed:SEXM
##                              -1.771808e-06
##     LOCATIONREGION 06:JOBSelfemployed:SEXM
##                               5.364470e-06
##     LOCATIONREGION 07:JOBSelfemployed:SEXM
##                               1.815363e-05
##     LOCATIONREGION 08:JOBSelfemployed:SEXM
##                               2.801365e-06
##     LOCATIONREGION 09:JOBSelfemployed:SEXM
##                              -5.021325e-06
##     LOCATIONREGION 10:JOBSelfemployed:SEXM
##                              -9.044808e-06
##     LOCATIONREGION 11:JOBSelfemployed:SEXM
##                               7.793583e-06
##          LOCATIONREGION 02:JOBService:SEXM
##                               1.330813e-05
##          LOCATIONREGION 03:JOBService:SEXM
##                              -1.110880e-05
##          LOCATIONREGION 04:JOBService:SEXM
##                               1.885062e-08
##          LOCATIONREGION 05:JOBService:SEXM
##                               1.291790e-06
##          LOCATIONREGION 06:JOBService:SEXM
##                               2.782997e-05
##          LOCATIONREGION 07:JOBService:SEXM
##                                         NA
##          LOCATIONREGION 08:JOBService:SEXM
##                               3.783515e-06
##          LOCATIONREGION 09:JOBService:SEXM
##                              -1.219085e-06
##          LOCATIONREGION 10:JOBService:SEXM
##                              -6.835778e-06
##          LOCATIONREGION 11:JOBService:SEXM
##                                         NA
##          LOCATIONREGION 02:JOBBusiness:AGE
##                              -2.951069e-07
##          LOCATIONREGION 03:JOBBusiness:AGE
##                              -2.479130e-06
##          LOCATIONREGION 04:JOBBusiness:AGE
##                               3.407004e-07
##          LOCATIONREGION 05:JOBBusiness:AGE
##                              -6.295374e-07
##          LOCATIONREGION 06:JOBBusiness:AGE
##                                         NA
##          LOCATIONREGION 07:JOBBusiness:AGE
##                                         NA
```

```
##          LOCATIONREGION 08:JOBBusiness:AGE
##                               -8.000520e-08
##          LOCATIONREGION 09:JOBBusiness:AGE
##                               -1.620948e-08
##          LOCATIONREGION 10:JOBBusiness:AGE
##                                1.733688e-07
##          LOCATIONREGION 11:JOBBusiness:AGE
##                                          NA
##      LOCATIONREGION 02:JOBSelfemployed:AGE
##                                2.371257e-07
##      LOCATIONREGION 03:JOBSelfemployed:AGE
##                                1.442140e-07
##      LOCATIONREGION 04:JOBSelfemployed:AGE
##                                4.340938e-07
##      LOCATIONREGION 05:JOBSelfemployed:AGE
##                                2.449317e-07
##      LOCATIONREGION 06:JOBSelfemployed:AGE
##                                1.380875e-07
##      LOCATIONREGION 07:JOBSelfemployed:AGE
##                                2.510680e-07
##      LOCATIONREGION 08:JOBSelfemployed:AGE
##                                5.139940e-07
##      LOCATIONREGION 09:JOBSelfemployed:AGE
##                               -8.582010e-09
##      LOCATIONREGION 10:JOBSelfemployed:AGE
##                                9.456776e-07
##      LOCATIONREGION 11:JOBSelfemployed:AGE
##                                3.689135e-07
##           LOCATIONREGION 02:JOBService:AGE
##                                4.125263e-07
##           LOCATIONREGION 03:JOBService:AGE
##                                1.496175e-08
##           LOCATIONREGION 04:JOBService:AGE
##                                4.757753e-07
##           LOCATIONREGION 05:JOBService:AGE
##                                7.007401e-07
##           LOCATIONREGION 06:JOBService:AGE
##                                2.244318e-07
##           LOCATIONREGION 07:JOBService:AGE
##                                          NA
##           LOCATIONREGION 08:JOBService:AGE
##                                4.105430e-07
##           LOCATIONREGION 09:JOBService:AGE
##                               -1.217710e-07
##           LOCATIONREGION 10:JOBService:AGE
##                                2.453950e-07
##           LOCATIONREGION 11:JOBService:AGE
##                                          NA
##                LOCATIONREGION 02:SEXM:AGE
##                               -1.576597e-07
```

```
##                  LOCATIONREGION 03:SEXM:AGE
##                                -3.321293e-08
##                  LOCATIONREGION 04:SEXM:AGE
##                                -1.898819e-07
##                  LOCATIONREGION 05:SEXM:AGE
##                                -1.677682e-07
##                  LOCATIONREGION 06:SEXM:AGE
##                                -2.140289e-07
##                  LOCATIONREGION 07:SEXM:AGE
##                                 2.233571e-07
##                  LOCATIONREGION 08:SEXM:AGE
##                                -2.325176e-07
##                  LOCATIONREGION 09:SEXM:AGE
##                                -7.995125e-09
##                  LOCATIONREGION 10:SEXM:AGE
##                                 1.242166e-07
##                  LOCATIONREGION 11:SEXM:AGE
##                                 3.275751e-07
##                       JOBBusiness:SEXM:AGE
##                                -1.188027e-07
##                    JOBSelfemployed:SEXM:AGE
##                                 1.675576e-07
##                        JOBService:SEXM:AGE
##                                 2.316297e-07
##     LOCATIONREGION 02:JOBBusiness:SEXM:AGE
##                                 4.722078e-07
##     LOCATIONREGION 03:JOBBusiness:SEXM:AGE
##                                 2.287015e-06
##     LOCATIONREGION 04:JOBBusiness:SEXM:AGE
##                                           NA
##     LOCATIONREGION 05:JOBBusiness:SEXM:AGE
##                                 6.530614e-07
##     LOCATIONREGION 06:JOBBusiness:SEXM:AGE
##                                           NA
##     LOCATIONREGION 07:JOBBusiness:SEXM:AGE
##                                           NA
##     LOCATIONREGION 08:JOBBusiness:SEXM:AGE
##                                 2.344789e-07
##     LOCATIONREGION 09:JOBBusiness:SEXM:AGE
##                                           NA
##     LOCATIONREGION 10:JOBBusiness:SEXM:AGE
##                                           NA
##     LOCATIONREGION 11:JOBBusiness:SEXM:AGE
##                                           NA
## LOCATIONREGION 02:JOBSelfemployed:SEXM:AGE
##                                 6.635080e-08
## LOCATIONREGION 03:JOBSelfemployed:SEXM:AGE
##                                -4.193875e-08
## LOCATIONREGION 04:JOBSelfemployed:SEXM:AGE
##                                -8.180159e-08
```

```
## LOCATIONREGION 05:JOBSelfemployed:SEXM:AGE
##                                1.604930e-08
## LOCATIONREGION 06:JOBSelfemployed:SEXM:AGE
##                               -5.609303e-08
## LOCATIONREGION 07:JOBSelfemployed:SEXM:AGE
##                               -3.316507e-07
## LOCATIONREGION 08:JOBSelfemployed:SEXM:AGE
##                               -4.694789e-08
## LOCATIONREGION 09:JOBSelfemployed:SEXM:AGE
##                                4.151637e-08
## LOCATIONREGION 10:JOBSelfemployed:SEXM:AGE
##                                         NA
## LOCATIONREGION 11:JOBSelfemployed:SEXM:AGE
##                                         NA
##      LOCATIONREGION 02:JOBService:SEXM:AGE
##                               -2.328322e-07
##      LOCATIONREGION 03:JOBService:SEXM:AGE
##                                1.465216e-07
##      LOCATIONREGION 04:JOBService:SEXM:AGE
##                                         NA
##      LOCATIONREGION 05:JOBService:SEXM:AGE
##                                         NA
##      LOCATIONREGION 06:JOBService:SEXM:AGE
##                               -4.369955e-07
##      LOCATIONREGION 07:JOBService:SEXM:AGE
##                                         NA
##      LOCATIONREGION 08:JOBService:SEXM:AGE
##                                         NA
##      LOCATIONREGION 09:JOBService:SEXM:AGE
##                                         NA
##      LOCATIONREGION 10:JOBService:SEXM:AGE
##                                         NA
##      LOCATIONREGION 11:JOBService:SEXM:AGE
##                                         NA
```

```
#Certain co - effieicents are 0 as there are no claims for this combination
and as a result of that , 0 would be predicted and so the co - efficient
would be 1/0. Which means the GLM couldnt converge to a single number.
#(d)
confint(model1,parm = "SEXM")
```

```
## Waiting for profiling to be done...
```

```
##         2.5 %        97.5 %
## -1.799749e-05  3.190735e-05
```

```
#Since the 95% confidence interval contains the number 0, we can conclude
that SEX is not a statistically significant variable.
#(e)
intercept.ci = confint(model1,parm = "(Intercept)")
```

```
## Waiting for profiling to be done...
```

```
intercept.ci[1] < 0.001 & intercept.ci[2] > 0.001
```

```
## 2.5 %
## FALSE
```

```
#Since the value 0.001 is not in between the CI , we can conclude that the
Intercept coefficient is not 0.001
#(f)
model0 = glm(CLAIM~1,
             data = claims_exp,
             family = Gamma("inverse"))
#One - Variable Models
model1a = update(model0,.~.+LOCATION)
model1b = update(model0,.~.+JOB)
model1c = update(model0,.~.+SEX)
model1d = update(model0,.~.+AGE)
AIC(model1a)
```

```
## [1] 35345.32
```

```
AIC(model1b)
```

```
## [1] 34079.99
```

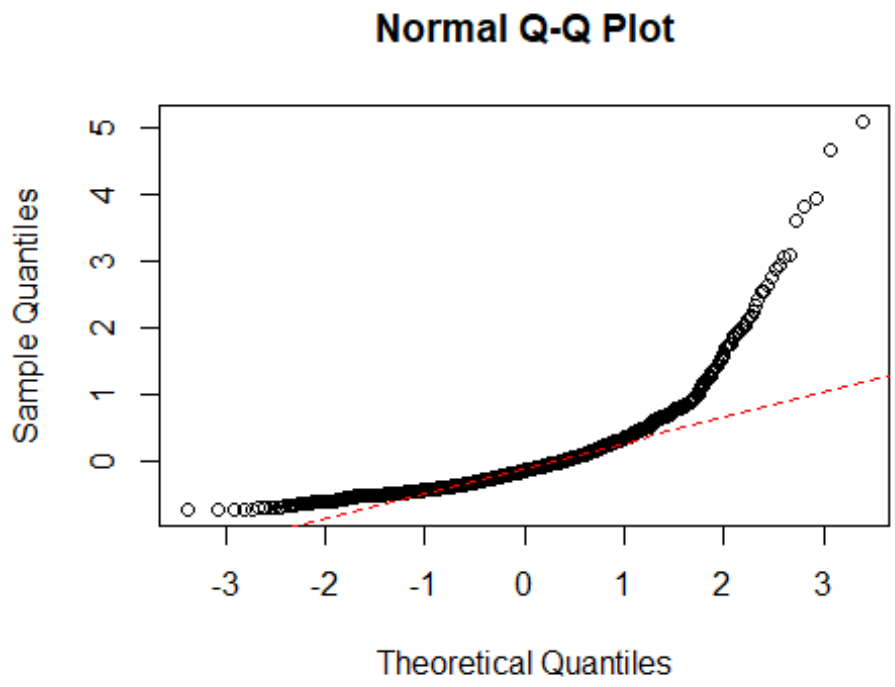
```
AIC(model1c)
```

```
## [1] 35695.06
```

```
AIC(model1d)
```

```
## [1] 33410.99
```

```
#Model1D is selected
#Similarly , the candidate will go forward with this method.

#(g)
qqnorm(resid(model1d,"pearson"))
qqline(resid(model1d,"pearson"),col = "red", lty = 2)
```




```
#(h)
sqrt(mean((claims_exp$CLAIM - fitted(model1d))^2))
```

```
## [1] 83460.68
```

```
#(i)
new_data1 = data.frame(AGE = 34,
                       SEX = "M",
                       LOCATION = "REGION 01",
                       JOB = "Business")
new_Data2 = data.frame(JOB = "Selfemployed",
                       AGE = 26,
                       SEX = "F",
                       LOCATION = "REGION 08")
predict(model1d,new_data1,type = "response")/predict(model1d,new_Data2,type =
"response")
```

```
##        1
## 1.235745
```