Assignment 3

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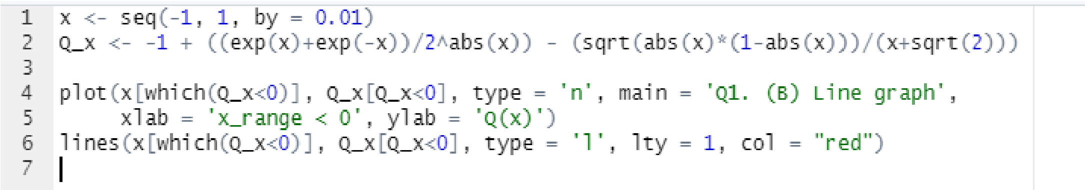
Q1.

1) **Source code :**

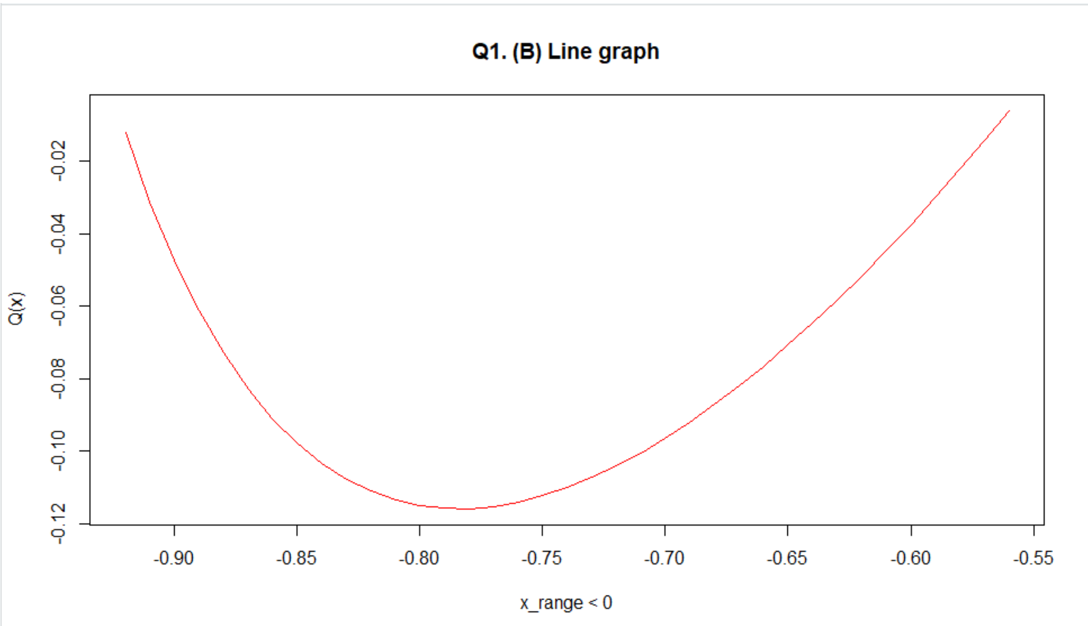
```
x <- seq(-1, 1, by = 0.01)

Q_x <- -1 + ((exp(x)+exp(-x))/2^abs(x)) - (sqrt(abs(x)*(1-abs(x)))/(x+sqrt(2)))


plot(x[which(Q_x<0)], Q_x[Q_x<0], type = 'n', main = 'Q1. (B) Line graph',

        xlab = 'x_range < 0', ylab = 'Q(x)')

lines(x[which(Q_x<0)], Q_x[Q_x<0], type = 'l', lty = 1, col = "red")
```

2) **R Screenshot :**



```
x <- seq(-1, 1, by = 0.01)
Q_x <- -1 + ((exp(x)+exp(-x))/2^abs(x)) - (sqrt(abs(x)*(1-abs(x)))/(x+sqrt(2)))

plot(x[which(Q_x<0)], Q_x[Q_x<0], type = 'n', main = 'Q1. (B) Line graph',
     xlab = 'x_range < 0', ylab = 'Q(x)')
lines(x[which(Q_x<0)], Q_x[Q_x<0], type = 'l', lty = 1, col = "red")
```

3) **Answer :**



Q2.

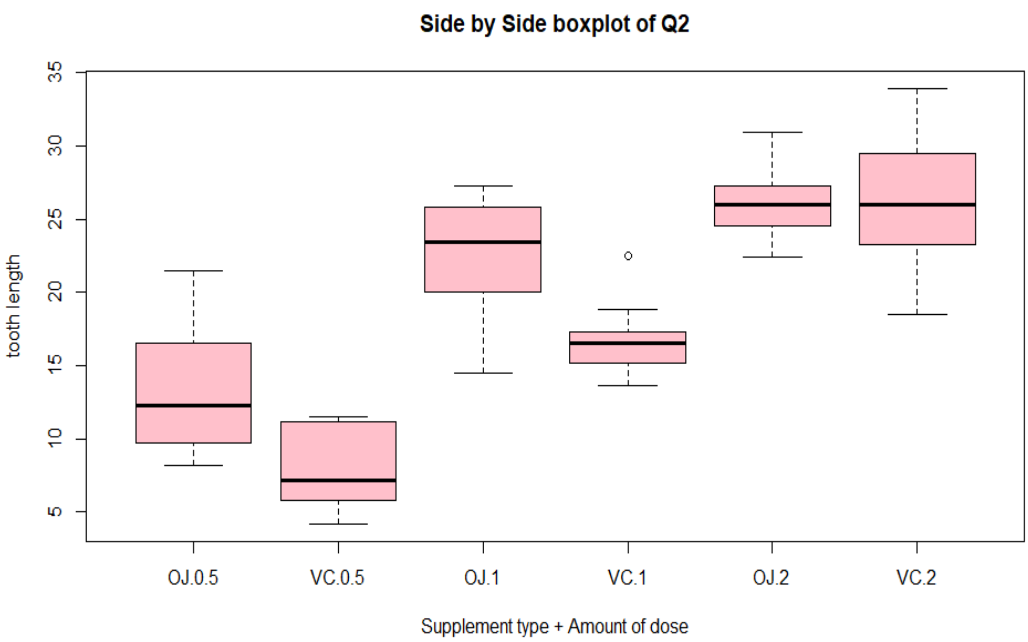
1) Source code :

```
Q2_data <- data.frame(ToothGrowth)

boxplot(len~supp+dose, data = Q2_data,

          main = "Side by Side boxplot of Q2",

          xlab = "Supplement type + Amount of dose",

          ylab = "tooth length",

         col = 'pink')
```

2) R Screenshot :

```
Q2_data <- data.frame(ToothGrowth)
boxplot(len~supp+dose, data = Q2_data,
        main = "Side by Side boxplot of Q2",
        xlab = "Supplement type + Amount of dose",
        ylab = "tooth length",
        col = 'pink')
```

3) Answer :



Q3.

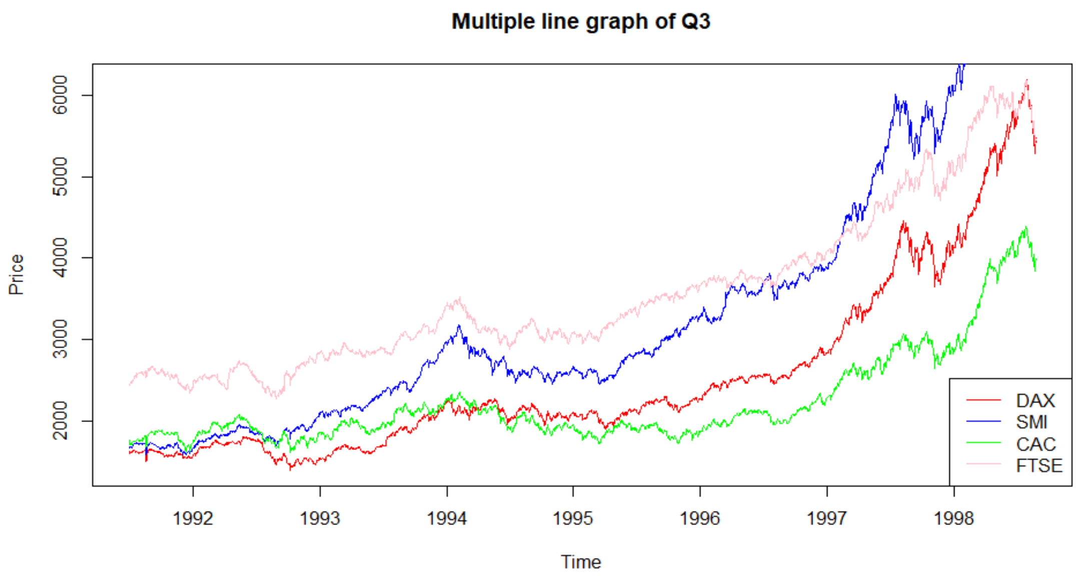
4) Source code :

```
Q3_data <- as.data.frame(EuStockMarkets)

x <- c(time(EuStockMarkets))

plot(x, Q3_data[, 'DAX'], type = 'n',

        main = "Multiple line graph of Q3",xlab = 'Time', ylab = "Price")

lines(x, Q3_data[,'DAX'], type = 'l', col = 'red')

lines(x, Q3_data[,'SMI'], type = 'l', col = 'blue')

lines(x, Q3_data[,'CAC'], type = 'l', col = 'green')

lines(x, Q3_data[,'FTSE'], type = 'l', col = 'pink')

legend("bottomright", legend = c('DAX', 'SMI', 'CAC', 'FTSE'), lty = 1,

          col = c('red', 'blue', 'green', 'pink'), cex = 1)
```

5) R Screenshot

```
Q3_data <- as.data.frame(EuStockMarkets)
x <- c(time(EuStockMarkets))
plot(x, Q3_data[, 'DAX'], type = 'n',
     main = "Multiple line graph of Q3",xlab = 'Time', ylab = "Price")
lines(x, Q3_data[,'DAX'], type = 'l', col = 'red')
lines(x, Q3_data[,'SMI'], type = 'l', col = 'blue')
lines(x, Q3_data[,'CAC'], type = 'l', col = 'green')
lines(x, Q3_data[,'FTSE'], type = 'l', col = 'pink')
legend("bottomright", legend = c('DAX', 'SMI', 'CAC', 'FTSE'), lty = 1,
       col = c('red', 'blue', 'green', 'pink'), cex = 1)
```

6) Answer :



Q4.

1) Source code :

my_data <- as.data.frame(penguins)

Q4_data <- my_data[c('species', 'bill_length_mm', 'bill_depth_mm')]

x <- Q4_data$bill_length_mm; y <- Q4_data$bill_depth_mm

plot(x, y, type = 'n',

main = 'Sactter plot of Q4', xlab = 'bill_length_mm', ylab = 'bill_depth_mm')

points(x[Q4_data['species'] == 'Adelie'], y[Q4_data['species'] == 'Adelie'], pch = 17, col = 'green')

points(x[Q4_data['species'] == 'Gentoo'], y[Q4_data['species'] == 'Gentoo'], pch = 18, col = 'blue')

points(x[Q4_data['species'] == 'Chinstrap'], y[Q4_data['species'] == 'Chinstrap'], pch = 19, col = 'red')

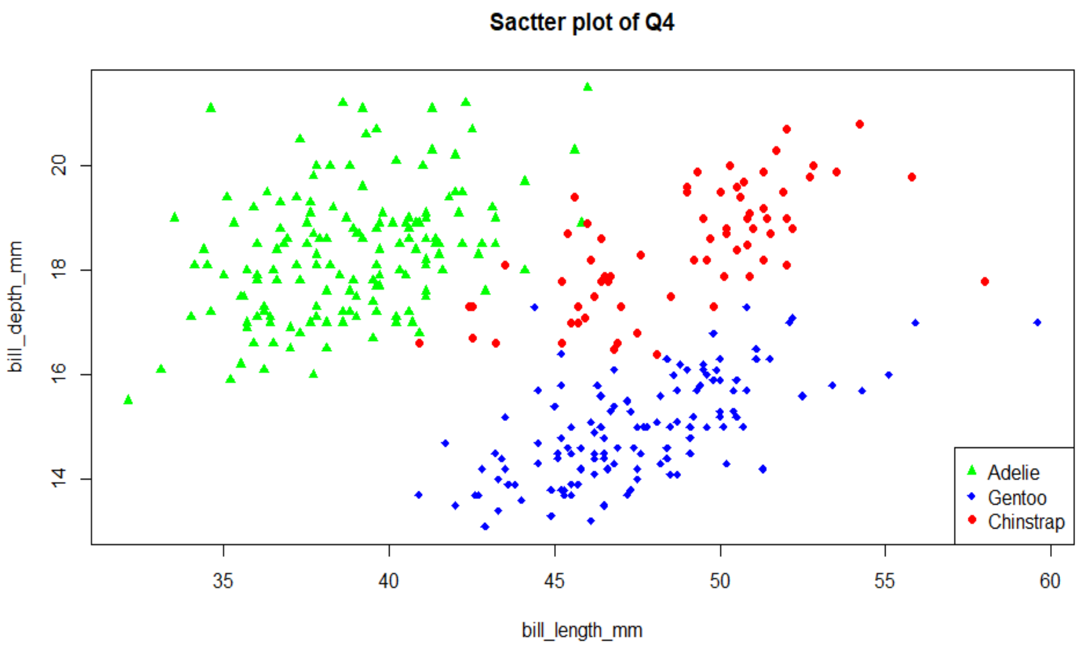
legend("bottomright", legend = c('Adelie', 'Gentoo', 'Chinstrap'),

pch = c(17,18,19), col = c('green', 'blue', 'red'))

2) R Screenshot :

```
library('palmerpenguins')
my_data <- as.data.frame(penguins)
Q4_data <- my_data[c('species', 'bill_length_mm', 'bill_depth_mm')]
x <- Q4_data$bill_length_mm; y <- Q4_data$bill_depth_mm
plot(x, y, type = 'n',
      main = 'Sactter plot of Q4', xlab = 'bill_length_mm', ylab = 'bill_depth_mm')
points(x[Q4_data['species'] == 'Adelie'], y[Q4_data['species'] == 'Adelie'], pch = 17, col = 'green')
points(x[Q4_data['species'] == 'Gentoo'], y[Q4_data['species'] == 'Gentoo'], pch = 18, col = 'blue')
points(x[Q4_data['species'] == 'Chinstrap'], y[Q4_data['species'] == 'Chinstrap'], pch = 19, col = 'red')
legend("bottomright", legend = c('Adelie', 'Gentoo', 'Chinstrap'),
        pch = c(17,18,19), col = c('green', 'blue', 'red'))
```

3) Answer :



Q5.

1) Source code :

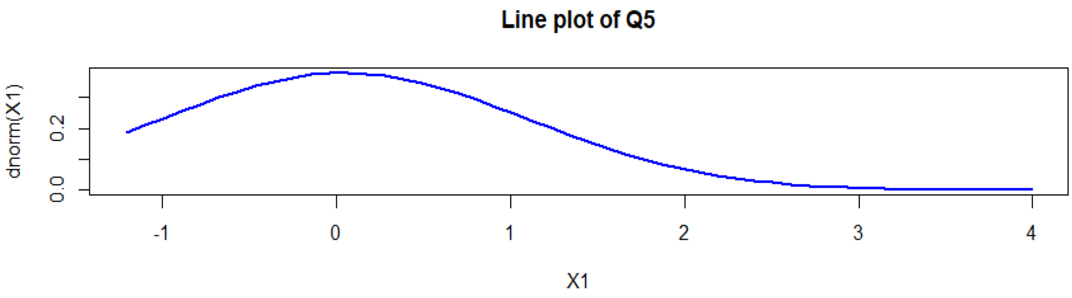
```
set.seed(1234)

U1 <- runif(1000); U2 <- runif(1000)

Z1 <- sqrt(-2*log(U1, base = exp(1)))*cos(2*pi*U1); Z2 <- sqrt(-2*log(U2, base = exp(1)))*cos(2*pi*U2)

sigma <- 1; mu <- 0

X1 <- sigma*Z1 + mu; X2 <- sigma*Z2 + mu

summary(X1); summary(X2)

xpts <- seq(min(X1), max(X1), length.out=50)

ypts <- dnorm(xpts, mean=mean(X1), sd=sd(X1))

par(mfrow = c(2,1))

plot(xpts, ypts, type = 'n', main = "Line plot of Q5", xlab = 'X1', ylab = 'dnorm(X1)')

lines(xpts, ypts, lwd=2, col="blue")


xpts1 <- seq(min(X2), max(X2), length.out=50)

ypts1 <- dnorm(xpts, mean=mean(X2), sd=sd(X2))

plot(xpts1, ypts1, type = 'n', main = "Line plot of Q5", xlab = 'X2', ylab = 'dnorm(X2)')

lines(xpts1, ypts1, lwd=2, col="blue")
```

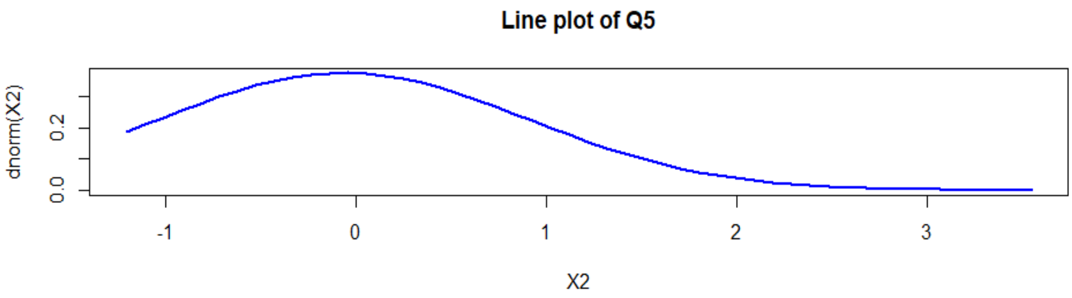
2) R Screenshot :

```
set.seed(1234)
U1 <- runif(1000); U2 <- runif(1000)
Z1 <- sqrt(-2*log(U1, base = exp(1)))*cos(2*pi*U1); Z2 <- sqrt(-2*log(U2, base = exp(1)))*cos(2*pi*U2)
sigma <- 1; mu <- 0
X1 <- sigma*Z1 + mu; X2 <- sigma*Z2 + mu
summary(X1); summary(X2)
xpts <- seq(min(X1), max(X1), length.out=50)
ypts <- dnorm(xpts, mean=mean(X1), sd=sd(X1))
par(mfrow = c(2,1))
plot(xpts, ypts, type = 'n', main = "Line plot of Q5", xlab = 'X1', ylab = 'dnorm(X1)')
lines(xpts, ypts, lwd=2, col="blue")

xpts1 <- seq(min(X2), max(X2), length.out=50)
ypts1 <- dnorm(xpts, mean=mean(X2), sd=sd(X2))
plot(xpts1, ypts1, type = 'n', main = "Line plot of Q5", xlab = 'X2', ylab = 'dnorm(X2)')
lines(xpts1, ypts1, lwd=2, col="blue")
```

3) Answer : They are follow the standard normal distribution

```
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max. 
-1.207709 -0.809031 -0.003992  0.047391  0.358332  3.995300 
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max. 
-1.20770 -0.86485 -0.06343  0.03964  0.36029  3.55093 
```





Q6.

1) Source code :

```
f <- function(x) x^4-9*x^3-334*x^2+4416*x-10080
fprime <- function(x) 4*x^3-27*x^2-668*x + 4416
par(mfrow = c(2,2))
Newton <- function(x, tol = 10^(-10)) {
        curve(f, from = -35, to = 35, col = 'blue', main = 'Newton Method', xlab = 'X', ylab = 'f(x)')
        text(x=x, y=f(x), labels="1st label : ")
        while(abs(f(x)) > tol) {
                x <- x - (f(x)/fprime(x))
                points(x, f(x), pch = 18, col = 'red')
        }

}
Descent <- function(x, tol = 10^(-10)) {
        curve(fprime, from = -35, to = 35, col = 'blue',
              main = 'Steepest Descent Algorithm', xlab = 'X', ylab = 'fprime(x)')
        text(x=x, y=fprime(x), labels="1st label")
        alpha = 10^(-5)
        while(abs(alpha*fprime(x)) > tol) {
                x <- x -(alpha*fprime(x))
                points(x, fprime(x), pch = 18, col = 'red')
        }
}
Newton(-30)
Newton(30)
Descent(-30)
Descent(30)
```

2) R Screenshot :

```r
f <- function(x) x^4-9*x^3-334*x^2+4416*x-10080
fprime <- function(x) 4*x^3-27*x^2-668*x + 4416
par(mfrow = c(2,2))
Newton <- function(x, tol = 10^(-10)) {
        curve(f, from = -35, to = 35, col = 'blue', main = 'Newton Method', xlab = 'X', ylab = 'f(x)')
        text(x=x, y=f(x), labels="1st label : ")
        while(abs(f(x)) > tol) {
                x <- x - (f(x)/fprime(x))
                points(x, f(x), pch = 18, col = 'red')
        }

}
Descent <- function(x, tol = 10^(-10)) {
        curve(fprime, from = -35, to = 35, col = 'blue',
              main = 'Steepest Descent Algorithm', xlab = 'X', ylab = 'fprime(x)')
        text(x=x, y=fprime(x), labels="1st label")
        alpha = 10^(-5)
        while(abs(alpha*fprime(x)) > tol) {
                x <- x -(alpha*fprime(x))
                points(x, fprime(x), pch = 18, col = 'red')
        }
}
Newton(-30)
Newton(30)
Descent(-30)
Descent(30)
```

3) Answer :