R-Programming Lab : Assignment 2

**Question1**

Find the minimum of the function **f(x)=0.65-(0.75/(1+x^2))-0.65*x*atan(1/x)**  
using Newton’s method.

**Defining function**

**f(x)**

func <- function(x) {  
   
 0.65-(0.75/(1+x^2))-0.65\*x\*atan(1/x)  
   
}

**f’(x)**<-first derivative of f(x)

func1<- function(x) {  
 (1.5\*(x/(1+x^2)^2))+0.65\*x/(1+x^2)-0.65\*atan(1/x)  
}

**f"(x)**<-Second derivative of f(x)

func2 <- function(x) {  
 (1.5\*(1-3\*x^2)/(1+x^2)^3)+0.65/(1+x^2)+0.65\*(1-x^2)/(1+x^2)^2  
}

**func1 is first derivative of func(or f(x) )**  
**func2 is Second derivative of func(or f(x) )**

**choosing randomly 100 guess and tolerance is 0.00001**

guess <-seq(0.005,0.5,0.005) #100 guess  
tolerance <- .00001 #tolerance

cat("randomly chosen guess is:\n",guess)

## randomly chosen guess is:  
## 0.005 0.01 0.015 0.02 0.025 0.03 0.035 0.04 0.045 0.05 0.055 0.06 0.065 0.07 0.075 0.08 0.085 0.09 0.095 0.1 0.105 0.11 0.115 0.12 0.125 0.13 0.135 0.14 0.145 0.15 0.155 0.16 0.165 0.17 0.175 0.18 0.185 0.19 0.195 0.2 0.205 0.21 0.215 0.22 0.225 0.23 0.235 0.24 0.245 0.25 0.255 0.26 0.265 0.27 0.275 0.28 0.285 0.29 0.295 0.3 0.305 0.31 0.315 0.32 0.325 0.33 0.335 0.34 0.345 0.35 0.355 0.36 0.365 0.37 0.375 0.38 0.385 0.39 0.395 0.4 0.405 0.41 0.415 0.42 0.425 0.43 0.435 0.44 0.445 0.45 0.455 0.46 0.465 0.47 0.475 0.48 0.485 0.49 0.495 0.5

**code of newton raphson for finding minima of function**

root <- function(func1,func2, guess, tolerance) {  
 x = guess  
 while (abs(func1(x)) > tolerance) {  
 x = x - func1(x)/func2(x)  
 }  
 return(x)  
}

**Finding minima of function for 100 points**  
for finding minima of function using newton raphson method we need one guess (one arbitaray point )

minima<-0  
for(i in 1:100){  
 x=guess[i]  
 minima[i]<-root(func1,func2,x,tolerance)  
}

**minimum value of f(x)**

minima

## [1] 0.4808636 0.4808636 0.4808636 0.4808637 0.4808637 0.4808637 0.4808637  
## [8] 0.4808637 0.4808638 0.4808638 0.4808638 0.4808638 0.4808639 0.4808639  
## [15] 0.4808639 0.4808640 0.4808640 0.4808640 0.4808641 0.4808641 0.4808641  
## [22] 0.4808641 0.4808642 0.4808642 0.4808642 0.4808642 0.4808643 0.4808643  
## [29] 0.4808643 0.4808643 0.4808643 0.4808644 0.4808644 0.4808644 0.4808644  
## [36] 0.4808644 0.4808644 0.4808644 0.4808644 0.4808644 0.4808645 0.4808645  
## [43] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [50] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [57] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808561  
## [64] 0.4808575 0.4808588 0.4808598 0.4808607 0.4808615 0.4808621 0.4808626  
## [71] 0.4808630 0.4808634 0.4808636 0.4808639 0.4808640 0.4808642 0.4808643  
## [78] 0.4808643 0.4808644 0.4808644 0.4808644 0.4808645 0.4808645 0.4808645  
## [85] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808591 0.4808617  
## [92] 0.4808633 0.4808641 0.4808644 0.4808645 0.4808631 0.4808645 0.4808644  
## [99] 0.4808642 0.4808634

**Value of function f(x) at minima (x=0.48)**

func(minima)

## [1] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [7] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [13] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [19] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [25] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [31] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [37] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [43] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [49] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [55] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [61] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [67] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [73] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [79] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [85] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [91] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [97] -0.3100205 -0.3100205 -0.3100205 -0.3100205

**using inbuilt function(newtonRaphson)**

**Finding minima function using library function**

library(pracma)  
  
out<-0   
  
for(i in 1:100){  
 x=guess[i]  
 out[i]<-newtonRaphson(func1,x,tol=0.00001)$root  
   
   
}

**minimum value of f(x)**

out

## [1] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [8] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [15] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [22] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [29] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [36] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [43] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [50] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [57] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [64] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
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## [85] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [92] 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645 0.4808645  
## [99] 0.4808645 0.4808645

**Value of function f(x) at mimima (using inbuilt function)**

func(out)

## [1] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [7] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
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## [25] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
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## [85] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
## [91] -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205 -0.3100205  
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**Solution Agreement with library function**

own\_ans<-func(minima)  
lib\_ans<-func(out)

data.frame(own\_ans,lib\_ans)

## own\_ans lib\_ans  
## 1 -0.3100205 -0.3100205  
## 2 -0.3100205 -0.3100205  
## 3 -0.3100205 -0.3100205  
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## 99 -0.3100205 -0.3100205  
## 100 -0.3100205 -0.3100205

from above dataframe you can observe that the data in column 1(own\_ans) is exactly equal to column 2(lib\_ans) as expected.