```r
#newtonraphson function
newtonraphson <- function(ftn, x0, tol = 1e-9, max.iter = 100) {
  x <- x0 # x0: the initial value
  fx <- ftn(x)
  iter <- 0
  while ((abs(fx[1]) > tol) & (iter < max.iter)) {
    x <- x - fx[1]/fx[2]
    fx <- ftn(x)
    iter <- iter + 1
    cat("At iteration", iter, "value of x is:", x, "\n")
  }
  if (abs(fx[1]) > tol) {
    cat("Algorithm failed to converge\n")
    return(NULL)
  } else { # abs(fx[1]) <= tol
    cat("Algorithm converged\n")
    return(x)
  }
}
```

```
#Ex 21 (Part 1) using Newton-Raphson method to calculate exact C.I.
no.rep <- 1000 #replication
p <- 0.15; n <- 20 #binomial(n=20,p=0.15)
le95 <- rep(NA,no.rep) #lower bound
re95 <- rep(NA,no.rep) #upper bound
x<-c()
for(i in 1:no.rep){
  set.seed(i)
  x[i] <- rbinom(1,n,p)}
   for(i in 1: no.rep){
     if (x[i] != 0) {
       paste(x[i])
     }else{
        x[i]  <- rbinom(1,n,p)
     }
ftn1 <- function(p) {
  fp <- (-0.975)
  dfp <- 0
  for (k in 0:x[i]-1) {
   fp <- fp+choose(20,k)*(p^k)*((1-p)^(20-k))
   dfp <- dfp+choose(20,k)*(k*(p^(k-1))*((1-p)^(20-k))-(p^k)*(20-k)*((1-p)^(19-k)))
  }
  return(c(fp, dfp))
}
#PU
ftn2 <- function(p) {
  fp <- (-0.025)
  dfp <- 0
  for (k in 0:x[i]) {
   fp <- fp+choose(20,k)*(p^k)*((1-p)^(20-k))
   dfp <- dfp+choose(20,k)*(k*(p^(k-1))*((1-p)^(20-k))-(p^k)*(20-k)*((1-p)^(19-k)))
  }
  return(c(fp, dfp))
}
le95[i] <-newtonraphson(ftn1,0.1, 1e-9)
re95[i] <-newtonraphson(ftn2,0.25, 1e-9)
 }
mean(re95-le95) #length
mean((le95<=p) & (p<=re95)) #coverage
```

Output:

At iteration 6 value of x is: 0.436614
Algorithm converged
At iteration 1 value of x is: -0.2158834
At iteration 2 value of x is: -0.1562778
At iteration 3 value of x is: -0.1015528
At iteration 4 value of x is: -0.05423534
At iteration 5 value of x is: -0.01939507
At iteration 6 value of x is: -0.002268137
At iteration 7 value of x is: 0.001149229
At iteration 8 value of x is: 0.001264962
At iteration 9 value of x is: 0.001265089
At iteration 96 value of x is: -1964516727
At iteration 97 value of x is: -1866290891
At iteration 98 value of x is: -1772976346
At iteration 99 value of x is: -1684327529
At iteration 100 value of x is: -1600111152
Algorithm failed to converge
Error in le95[i] <- newtonraphson(ftn1, 0.1, 1e-09) :
  replacement has length zero

#Ex 21 (Part 2) generating random numbers and comparing coverage and length of 95%
asymptotic C.I.
l95 <- rep(NA,no.rep) #lower bound
r95 <- rep(NA,no.rep) #upper bound

for(i in 1:no.rep){
  set.seed(i)
  phat <- rbinom(1,n,p)/n
  l95[i] <- phat-qnorm(0.975)*sqrt((phat*(1-phat))/n)
  r95[i] <- phat+qnorm(0.975)*sqrt((phat*(1-phat))/n)
}
l95[l95 < 0] <- 0
mean(r95-l95) #length
mean((l95<=p) & (p<=r95)) #coverage

Output:
mean(r95-l95) #length
[1] 0.2765599
mean((l95<=p) & (p<=r95)) #coverage
[1] 0.803