

Assignment 3

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```
pacman::p_load(Rcpp, sloop)

f1 <- function(x, a=0) {
  # square each of the elements of x after subtracting scalar a
  return((x-a)^2)
}

f2 <- function(x,a=c(0,0)) {
  # distance of x from the point a in the 2D plane
  return(sqrt((x[1]-a[1])^2 + (x[2]-a[2])^2))
}
```

Question 1

Write R code to find the minimum value of the function `f1()` in the interval $-100 < x < 100$ when $a=4$ using `optimize()`. Show the R code and output.

```
xmin <- stats::optimize(f1, c(-100,100), a = 4)
print(xmin)
```

```
## $minimum
## [1] 4
##
## $objective
## [1] 0
```

Therefore minimum is at $x = 4$ where output is 0

Question 2

Write R code to find the minimum value of the function `f2()` when $a=(1,2)$ using `optim()`. Use $x=c(0,0)$ as a starting guess. Show the R code and output.

```
x2min <- stats::optim(c(0,0), f2, a = c(1,2))
print(x2min)
```

```
## $par
## [1] 1 2
##
## $value
## [1] 2.736217e-08
##
## $counts
```

```
## function gradient
##      113      NA
##
## $convergence
## [1] 0
##
## $message
## NULL
```

The function found that it could find an almost 0 distance if it selected the exact point of (1,2) after 113 iterations. While the distance is not exactly 0 it effectively is.

Question 3

```
koptim <- function(par, fn, ..., control = list(fnscale = 1)){
  if(length(par)==1){
    max_trigger <- ifelse(control$fnscale == -1, T,
                          ifelse(control$fnscale == 1, F,
                                stop('fnscale value 1 for minimum and -1 for maximum')))

    trigger <- F
    increase_distance <- 5
    increase_counter <- 0
    while(trigger == F){
      if(increase_counter >= 10){stop(paste('No max/min found within +/- ', 5^10, ' of estimate, please
      xmin_a <- stats::optimize(fn, c(par-increase_distance,
                                     par+increase_distance),
                               ...,
                               maximum = max_trigger )
      xmin_b <- stats::optimize(fn, c(par-(5*increase_distance),
                                     par+(5*increase_distance)),
                               ...,
                               maximum = max_trigger)

      if(any(is.null(c(xmin_a$minimum, xmin_b$minimum))) & increase_counter < 10){
        increase_distance <- 5 * increase_distance
        increase_counter <- increase_counter + 1
      }
      else if(xmin_a$minimum != xmin_b$minimum & increase_counter < 10){
        increase_distance <- 5 * increase_distance
        increase_counter <- increase_counter + 1
      } else{

        trigger <- T
        outputs<- list(par = c(xmin_a$minimum),
                       value = c(xmin_a$objective))
      }
    }
  }
  else if(length(par)>1){
    xmin <- stats::optim(par = par, fn = fn, control = control, ...)
    outputs<- list(par = c(xmin$par),
                  value = c(xmin$value))
  }
}
```

```
    return(outputs)
}
```

Question 4

```
koptim(c(0),f1, a = c(4))
```

```
## $par
## [1] 4
##
## $value
## [1] 0
```

```
koptim(c(0,0),f2, a = c(1,2))
```

```
## $par
## [1] 1 2
##
## $value
## [1] 2.736217e-08
```