STAT 527 HW 5

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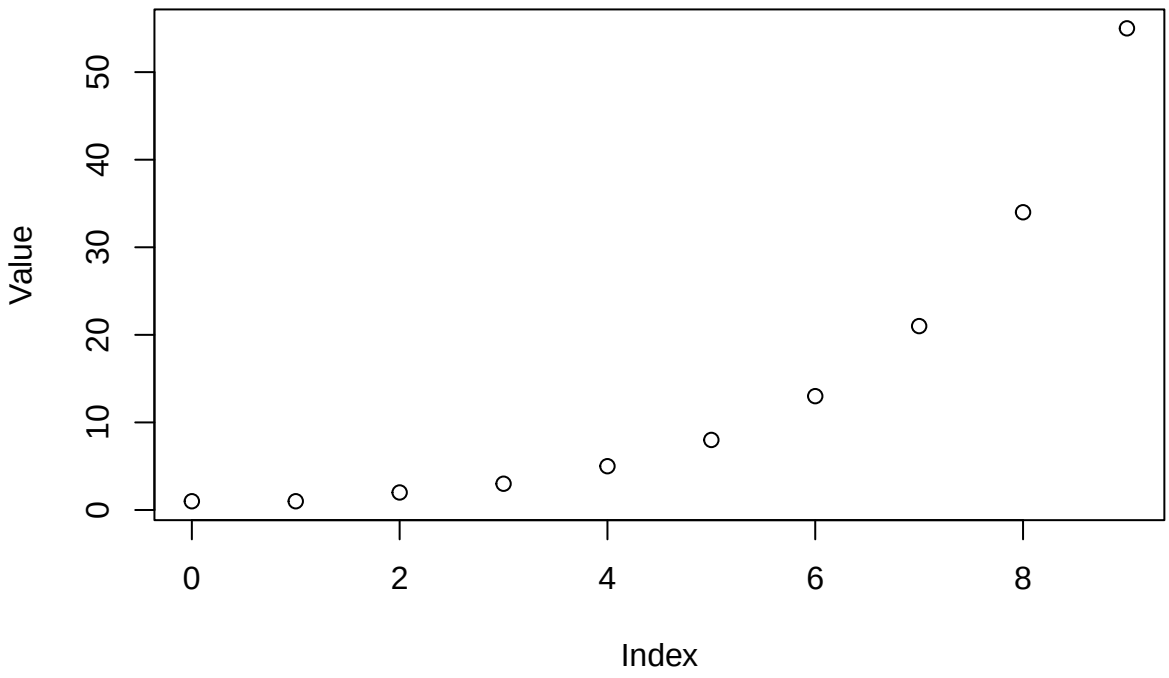
20 February 2023

1. (10 points) Fibonacci sequence. If you put some coefficients in the recursion, like ri+1 = ari + bri-1, where you choose the numbers a and b, then you will have an entirely new sequence. Write a function that takes a, b and the sequence length n as arguments. The function should return the entire sequence. Choose appropriate input arguments and plot the returned sequence.

```
my_list <- list()
r <- function(a, b, n) {
    # start with i = 1 and i-1 = 0
    i <- 0; r1 <- 0; r2 <- 1
    while (i < n) {
        print(r1)
        r3 <- a * r2 + b * r1
        # update values
        i <- i + 1
        r1 <- r2
        r2 <- r3
        # add the Fibonacci sequences in the list
        my_list[[length(my_list) + 1]] <- r1
    }
    return(my_list)
}
# Choose a = 1, b = 1, n = 10
l <- r(1, 1, 10)
```

```
## [1] 0
## [1] 1
## [1] 1
## [1] 2
## [1] 3
## [1] 5
## [1] 8
## [1] 13
## [1] 21
## [1] 34
```

```
plot(0:9, l, xlab = "Index", ylab = "Value")
```



2. (20 points) 0-1 knapsack problem. Given a set of items, each with a weight and a value, determine which items to include in the collection so that the total weight is less than or equal to a given limit and the total value is as large as possible. Mathematically, given a set of n items numbered from 1 up to n, each with a weight wi and a value vi, along with a maximum weight capacity W (assumed to be an integer), the 0-1 knapsack problem aims to solve the following optimization problem:

```
wt <- c(10, 20, 30)
vt <- c(60, 100, 120)
w <- 50
n <- length(wt)
M <- matrix(0, nrow = n + 1, ncol = w)
k <- function(x) {x + 1}

# function (wt = weight, vt = value, w = limit)
Knapsack <- function(wt, vt, w) {
    # to skip the first row, start with 2 to k(n)
    for (i in 2:k(n)) {
        for (j in 1:w) {
    # if the weight of new item is over j-th, use the value at {(i-1), j}
            if (j < wt[i - 1]) {
                M[i, j] <- M[i - 1, j]
            }
    # ifelse, comparing m[i-1,w] & m[i-1,w-wi]+v and pick the bigger one
        else {
            M[i, j] <- max(M[i - 1, j], M[i - 1, j - wt[i - 1]] + vt[i - 1])
```

```
            }
        }
    }
    # change the row names
    rownames(M) <- 0:3
    # get the maximum value in the matrix
    M <- max(M)
    return(M)
}

# wt = {10,20,30}, vt = {60,100,120} and W = 50
M <- Knapsack(wt, vt, w)
M
```

```
## [1] 180
```