1. Create an m x n matrix with replicate(m, rnorm(n)) with m=10 column vectors of n=10 elements each, constructed with rnorm(n), which creates random normal numbers.

Then we transform it into a dataframe (thus 10 observations of 10 variables) and perform an algebraic operation on each element using a nested for loop: at each iteration, every element referred by the two indexes is incremented by a sinusoidal function, compare the vectorized and non-vectorized form of creating the solution and report the system time differences.

# With loop

set.seed(42)

m <-10

n <-10

mymat<-replicate(m, rnorm(n)) # create matrix of normal random numbers

mydframe=data.frame(mymat) # transform into data frame

for (i in 1:m) {

for (j in 1:n) {

mydframe[i,j]<-mydframe[i,j] + 10\*sin(0.75\*pi)

print(mydframe)

}

}

# with vector

set.seed(42)

m <-10

n <-10

mymat<-replicate(m, rnorm(n))

mydframe=data.frame(mymat)

mydframe<-mydframe + 10\*sin(0.75\*pi)

# measure loop execution

system.time(

for (i in 1:m) {

for (j in 1:n) {

mydframe[i,j]<-mydframe[i,j] + 10\*sin(0.75\*pi)

}

}

)

## user system elapsed

## 0.011 0.006 0.023

# measure vectorized execution

system.time(mydframe<-mydframe + 10\*sin(0.75\*pi) )

## user system elapsed

## 0.003 0.001 0.003