Problem12

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#library(expm)  
library(Matrix)  
library(matlib)

## Warning: package 'matlib' was built under R version 3.6.2

N <- 50 #POPULATI0N SIZE  
nrows <- N #select number of rows  
ncols <- N #number of columns  
product <- nrows\*ncols  
vec= rep(0,product)  
  
  
B <- 1 #CONATACT RATE  
rr <- 5/22 # Recovery rate  
br\_dr <- 5/22 # Birth rate = Death rate  
n <- 0  
  
# FUCTION new infections  
  
b <- function(x){  
 new\_inf <- x\*(N-x)\*((B)/N)  
 return(new\_inf)  
}  
# FUCTION new deaths  
  
d <- function(x){  
 new\_deaths <- (2\*rr)\*x  
 return(new\_deaths)  
}  
#Make matrix  
for(row in 1:nrows)  
{  
 for (column in 1:ncols){  
   
 if (row==1 && column == 1){  
 vec[column+n] <- -(b(row)+d(row))  
 }  
 else if (row==1 && column == 2){  
 vec[column+n] <- b(row)  
 }  
   
 else if(row - column == 1)  
 {  
 vec[column+n] <- d(row)  
 }  
 else if(row==column)  
 {  
 vec[column+n] <- -(d(row)+b(row))  
 }  
 else if(row-column == -1)  
 {  
 vec[column+n] <- b(row)  
 }  
   
 }  
 n <- n+ncols  
}  
 D <- matrix(vec, nrow = nrows,ncol = ncols, byrow = TRUE)  
View(D)  
  
### The computation  
one <- rep(1,N)  
ONE <- matrix(one)  
View(ONE)  
inverse\_D <- -1\*inv(D)  
View(inverse\_D)  
avg\_times <- inverse\_D %\*% ONE  
I <- D %\*% inverse\_D  
View(I)  
View(avg\_times)  
## part b  
  
# Here we solve the folowing equation:  
second\_moment <- inverse\_D %\*% avg\_times  
variance <- second\_moment - (avg\_times^2)  
View(variance)  
R\_0 <- B/(rr+br\_dr)  
R\_0

## [1] 2.2

plot(avg\_times, xlab = "Initial Number of Infecteds", ylab = "Time to Aborption")

