

# Family Unit Simulation

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```
##### Installing Packages #####
library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union

### Functions used ###
# Finds the missing integer in vector of integers
missing_int=function(vec) {
  n = length(vec)
  total = (n + 1)*(n + 2)/2
  sum_of_vec = sum(vec)
  return(total - sum_of_vec)
}

## Draws a random number from a uniform distribution (0,delta)
rand_time=function(){
  return(runif(1,0,delta))
}

## Randomly infects one person from the n family members
rand_inf=function(){
  return(sample.int(7,1))
}

## S->E Transition time random draw
susc_exp=function(curr_time){
  return(curr_time+rexp(1,(1/h*R0f*gamma_I)))
}

## E->I Transition time random draw
exp_infect=function(curr_time){
  return(curr_time+rexp(1,(1/gamma_E)))
}

## I->R Transition time random draw
infect_recov=function(curr_time){
  return(curr_time+rexp(1,(1/gamma_I)))
}
```

```
##### Setting Parameters, Functions, and initial conditions #####
R0f=5;gamma_E=1/5;gamma_I=1/7;n=7;delta=1;p=0.7;h=0.5

# Random time drawn and random infected person drawn
t=rand_time()
infect=rand_inf()

# Initialize State and Time Vectors
State=rep("S",n)
Time=rep(0,n)

#####

#### Next Action Time ####
action_time=function() {
  temp_action_Time=Time
  assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)

  # print(Time)

  # if no one is infected (E and below), Susceptible members have infinite (very large) values. If there
  if (!(("I" %in% State)) {

    # print("I is not in State")

    ## If only S and E in State
    if (((("S" %in% unique(State)) & ("E" %in% unique(State)) & (length(unique(State))==2))) {
      # Assigning big values for S individuals
      s=which(State=="S")
      temp_action_Time[s]=10000000
      e=which(State=="E")
      for (e in e) {
        temp_action_Time[e]=exp_infect(temp_action_Time[e])
      }

      # print(State)
      # print(temp_action_Time)

      assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)
      return(min(temp_action_Time))
    }

    ## If only R and S in State vector
    else if (((("R" %in% unique(State)) & ("S" %in% unique(State)) & (length(unique(State))==2))) {

      #print("Only R and S in State")

      s=which(State=="S")
      for (s in s) {
        temp_action_Time[s]=susc_exp(temp_action_Time[s])
      }
      r=which(State=="R")
      temp_action_Time[r]=1000000
    }
  }
}
```

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# print(State)
# print(temp_action_Time)

assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)
return(min(temp_action_Time))
}
## If only R and E in State vector
else if (((("R" %in% unique(State)) & ("E" %in% unique(State)) & (length(unique(State))==2))) {

#print("Only R and E in State")

e=which(State=="E")
for (e in e) {
  temp_action_Time[e]=exp_infect(temp_action_Time[e])
}
r=which(State=="R")
temp_action_Time[r]=1000000

#print(State)
#print(temp_action_Time)

assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)
return(min(temp_action_Time))
}
else {
  # Everything but I

  #print("Stuff")

  # Assigning big values for S individuals
  s=which(State=="S")
  for (s in s) {
    temp_action_Time[s]=susc_exp(temp_action_Time[s])
  }
  e=which(State=="E")
  for (e in e) {
    temp_action_Time[e]=exp_infect(temp_action_Time[e])
  }
  r=which(State=="R")
  temp_action_Time[r]=1000000

  # print(State)
  # print(temp_action_Time)

  assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)
  return(min(temp_action_Time))
}
}
else { #(("S" %in% State) | ("E" %in% State) | ("I" %in% State))

# print("I IS in State")

```

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# Updating Infect_Duration
i=which(State=="I")
Infect_Duration[i]=Infect_Duration[i]+temp_action_Time[i]
assign('Infect_Duration',Infect_Duration,envir = .GlobalEnv)

# print("printing Infect_Duration")

# print(Infect_Duration)

# Modifying S state individuals
s=which(State=="S")
for (s in s) {
  temp_action_Time[s]=susc_exp(temp_action_Time[s])
}
assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)
# Modifying E state individuals
e=which(State=="E")
for (e in e) {
  temp_action_Time[e]=exp_infect(temp_action_Time[e])
}
assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)
# Modifying I state individuals
i=which(State=="I")
for (i in i) {
  temp_action_Time[i]=infect_recov(temp_action_Time[i])
}
# Should we make the R people's action time infinite too?
r=which(State=="R")
for (r in r) {
  temp_action_Time[r]=1000000
}
assign('temp_action_Time',temp_action_Time,envir = .GlobalEnv)

#print(State)
#print(temp_action_Time)

return(min(temp_action_Time))
}

}

#####

#### Next Test Time ####
test_time=function() {

  #print(delta)

  temp_test_Time=delta
  assign('temp_test_Time',temp_test_Time,envir = .GlobalEnv)
  return(temp_test_Time)
}

```

```
#####

#### Algorithm ####
algo=function(t,infect,R0f,gamma_E,gamma_I,n,delta,p,h) {
  # First iteration process
  State[infect]="E"
  Time=rep(t,n)
  assign('State',State,envir = .GlobalEnv)
  assign('Time',Time,envir = .GlobalEnv)

  # print(State)
  # print(Time)
  # print("CHECK")

  # index to see how many iterations it takes
  i=0
  # index to see how many people have been tested
  c=0

  ### First checks if R is the only element in State vector ###
  while (!(("R" %in% unique(State)) & (length(unique(State))==1))) {
    i=i+1

    # print("CHECKWHILE")

    #### if we do not stop the algo:
    ### run action_time & test_time
    ## if action_time < test_time: then update the value of the smallest temp_Time index to simulate
    if (isTRUE(action_time()<test_time())) {

      # print("ACTION<TEST")

      # Updating Time vector
      Time[1:length(Time)]=min(temp_action_Time)
      assign('Time',Time,envir = .GlobalEnv)

      # print("ACTION")

      # Updating one individual in the State vector depending on smallest time.

      #print(State)

      if (State[which(temp_action_Time==min(temp_action_Time))]=="S") {
        State[which(temp_action_Time==min(temp_action_Time))]="E"
        assign('State',State,envir = .GlobalEnv)
        # print("S to E")
      }
      else if (State[which(temp_action_Time==min(temp_action_Time))]=="E") {
        State[which(temp_action_Time==min(temp_action_Time))]="I"
        assign('State',State,envir = .GlobalEnv)
        # print("E to I")
      }
      else { #(State[which(temp_action_Time==min(temp_action_Time))]=="I"

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        State[which(temp_action_Time==min(temp_action_Time))]="R"
        assign('State',State,envir = .GlobalEnv)
        # print("I to R")
    }
}
### else test_time < action_time ###
else {
    c=c+1
    # print("TEST<ACTION")

    # Here we test an infected person so commence end process calculations
    if (State[delta]=="I") {
        print("Tested an infected person")
        # go to end process calculations
        break
    }
    # If we do not test an infected person
    else {

        # print("Did not Test and Infected person")

        # Updating Time vector
        Time[1:length(Time)]=temp_test_Time
        assign('Time',Time,envir = .GlobalEnv)
        # Updating State vector
    }
    # cycle through which person to test
    if (delta==n) {
        delta=1
        assign('delta',delta,envir = .GlobalEnv)

        #print("CHECK1")
    }
    else {
        delta=delta+1
        assign('delta',delta,envir = .GlobalEnv)

        #print("CHECK2")
    }
}
# print(State)
}
assign('State',State,envir = .GlobalEnv)
assign('Time',Time,envir = .GlobalEnv)
assign('delta',delta,envir = .GlobalEnv)

#### End Process Calculations ####

# What is delta?
print(paste("Delta =",delta))

#print("DO END PROCESS CALCULATIONS")

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    #print(Time)
    print(State)

    print(paste("Number of iterations =",i))
    #return(i)
    print(paste(c,"people were tested"))

    ## Number of members that are Exposed or higher ##
    print(paste("Number of individuals Exposed or higher =",sum(("E"==State)|("I"==State)|("R"==State))))
    ## Duration each person has been infected
    assign('Infect_Duration',Infect_Duration,envir = .GlobalEnv)
    print("Duration of time each individual is infected:")
    print(Infect_Duration)

    print("")
}

```

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##### Run Simulation Once #####
R0f=5;gamma_E=1/5;gamma_I=1/7;n=7;delta=1;p=0.7;h=0.5
t=rand_time()
infect=rand_inf()
# Initialize State and Time Vectors
State=rep("S",n)
Time=rep(0,n)
Infect_Duration=rep(0,n)
# Run algorithm
algo(t,infect,R0f,gamma_E,gamma_I,n,delta,p,h)

```

```

## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.005437 3.122560 10.742625 2.561043 1.775534 9.855818 13.744935
## [1] ""

```

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##### Run Simulation n times #####
n=60
test=vector(mode = "list", length = n)
for (i in 1:n) {
  print(paste("Simulation",i))
  R0f=5;gamma_E=1/5;gamma_I=1/7;n=7;delta=1;p=0.7;h=0.5
  t=rand_time()
  infect=rand_inf()
  # Initialize State and Time Vectors
  State=rep("S",n)
  Time=rep(0,n)
  Infect_Duration=rep(0,n)
  # Run algorithm
  algo(t,infect,R0f,gamma_E,gamma_I,n,delta,p,h)
}

```

```

## [1] "Simulation 1"
## [1] "Delta = 5"

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```

## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.8142504 1.6621438 2.9891907 2.1144276 4.6241421 1.1451035 1.2761848
## [1] ""
## [1] "Simulation 2"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.1707253 4.5068312 2.6427587 0.9069877 3.3175942 2.1768425 4.6720739
## [1] ""
## [1] "Simulation 3"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.318802 4.567848 2.672292 1.586434 2.596569 2.284207 1.447620
## [1] ""
## [1] "Simulation 4"
## [1] "Delta = 5"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 5.941307 4.228921 1.335846 5.115809 1.894549 12.741619 2.058092
## [1] ""
## [1] "Simulation 5"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.3886061 0.6823360 2.4492354 1.9006036 2.3472514 2.6181419 2.5353612
## [1] ""
## [1] "Simulation 6"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.281693 2.542309 1.690103 5.939964 3.548123 3.629324 2.067212
## [1] ""
## [1] "Simulation 7"
## [1] "Delta = 3"

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## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 10.070432 7.769745 2.228328 3.393057 6.684895 1.327616 2.288566
## [1] ""
## [1] "Simulation 8"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.627984 1.555624 6.238631 8.370845 1.451276 2.197231 2.209266
## [1] ""
## [1] "Simulation 9"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.103333 4.151802 1.955948 3.200043 3.779978 2.029197 1.511696
## [1] ""
## [1] "Simulation 10"
## [1] "Tested an infected person"
## [1] "Delta = 1"
## [1] "I" "R" "R" "R" "I" "I" "S"
## [1] "Number of iterations = 15"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 6"
## [1] "Duration of time each individual is infected:"
## [1] 2.8606729 6.0287822 2.0694407 0.6787612 1.9430990 0.9798643 0.0000000
## [1] ""
## [1] "Simulation 11"
## [1] "Delta = 5"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.463107 3.322016 3.525163 3.501053 15.107710 4.385026 5.147917
## [1] ""
## [1] "Simulation 12"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.6987605 2.7266620 4.8325647 1.9960612 2.7140166 3.7325342 3.0070374
## [1] ""
## [1] "Simulation 13"

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## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.7203287 0.4720803 1.1490774 1.8411366 4.0546528 4.1594177 10.6138470
## [1] ""
## [1] "Simulation 14"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.5741100 6.1331378 0.7847653 2.3678145 1.5153564 0.5463701 5.8354223
## [1] ""
## [1] "Simulation 15"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 3.726609 7.895593 12.168749 3.492593 4.482673 5.985196 2.056792
## [1] ""
## [1] "Simulation 16"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.7814733 1.6535808 2.6869834 0.8674334 1.3520763 1.1511396 1.5274336
## [1] ""
## [1] "Simulation 17"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 7.4306658 4.5759913 1.8129334 4.3613912 1.3439543 0.7068575 1.3041247
## [1] ""
## [1] "Simulation 18"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.3869841 1.8749096 1.0125821 0.6579683 1.0549731 5.8673503 3.4483248
## [1] ""
## [1] "Simulation 19"

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## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.2789417 1.8044749 5.9411557 2.1038138 5.6135671 0.5026091 4.4756903
## [1] ""
## [1] "Simulation 20"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.9458589 3.0670132 3.3757735 1.1721729 1.3011910 7.6893035 1.8400795
## [1] ""
## [1] "Simulation 21"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 3.9648009 0.9477974 0.9743651 1.1911135 2.9195015 4.2642032 0.7974381
## [1] ""
## [1] "Simulation 22"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.803241 1.041127 2.636805 3.818118 4.906475 3.179538 3.387961
## [1] ""
## [1] "Simulation 23"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.7770130 2.0204105 1.1164194 4.7672591 4.0873606 0.5947307 3.2528728
## [1] ""
## [1] "Simulation 24"
## [1] "Delta = 5"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 3.267716 6.417590 1.331797 2.523185 1.748433 1.086799 4.861940
## [1] ""
## [1] "Simulation 25"

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## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.4981399 3.2553388 5.1519353 1.6803973 1.9132676 1.2712852 2.0407346
## [1] ""
## [1] "Simulation 26"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.5145837 1.9073554 2.7214966 0.7145215 0.7660808 0.1945105 1.2749254
## [1] ""
## [1] "Simulation 27"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.2731552 0.6548891 1.0188130 0.4352179 2.4371914 1.7689300 3.5245571
## [1] ""
## [1] "Simulation 28"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.267841 1.366065 2.769656 3.506245 1.582646 1.920094 3.350024
## [1] ""
## [1] "Simulation 29"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.6022406 1.3621004 3.4523484 3.5581997 0.5373334 0.1588952 5.4628040
## [1] ""
## [1] "Simulation 30"
## [1] "Tested an infected person"
## [1] "Delta = 1"
## [1] "I" "S" "R" "S" "S" "S" "S"
## [1] "Number of iterations = 5"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 2"
## [1] "Duration of time each individual is infected:"
## [1] 1.777540 0.000000 2.498743 0.000000 0.000000 0.000000 0.000000
## [1] ""

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## [1] "Simulation 31"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.180112 12.022196 8.713127 1.585748 2.292667 8.492604 1.342616
## [1] ""
## [1] "Simulation 32"
## [1] "Delta = 5"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 4.1503723 3.8295681 3.9645150 0.9102591 2.8984814 4.8781765 5.1351827
## [1] ""
## [1] "Simulation 33"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.0946339 1.1497751 0.8064117 0.7564425 0.9044550 3.4291018 1.2234124
## [1] ""
## [1] "Simulation 34"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.127090 1.513758 3.245503 2.032331 0.825878 4.760049 1.942786
## [1] ""
## [1] "Simulation 35"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.5385681 1.0591484 2.6948988 0.6836128 2.7677994 0.6347158 1.5288880
## [1] ""
## [1] "Simulation 36"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 9.147720 1.781040 9.447417 10.221112 6.980234 1.485034 2.909888
## [1] ""

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## [1] "Simulation 37"
## [1] "Tested an infected person"
## [1] "Delta = 2"
## [1] "R" "I" "R" "S" "R" "R" "R"
## [1] "Number of iterations = 18"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 6"
## [1] "Duration of time each individual is infected:"
## [1] 0.2645369 1.9718218 2.9949398 0.0000000 1.0102974 1.9193894 1.3993935
## [1] ""
## [1] "Simulation 38"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.5940865 4.2752718 2.3799724 1.5258265 3.0067427 0.5878586 2.2707247
## [1] ""
## [1] "Simulation 39"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 3.1382127 0.5303549 1.9767028 2.1720974 5.2725006 2.1658218 2.2556234
## [1] ""
## [1] "Simulation 40"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.6246699 6.8453129 0.8603636 3.9347872 1.0627369 9.6414448 2.1333158
## [1] ""
## [1] "Simulation 41"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.0978907 0.7718329 0.8033410 3.5676199 1.0494766 1.3658847 0.4346315
## [1] ""
## [1] "Simulation 42"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 3.220378 2.299968 1.858334 1.445450 1.545037 3.462132 1.138412

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## [1] ""
## [1] "Simulation 43"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 3.664472 2.718127 1.466369 2.301378 6.861330 2.664654 1.162888
## [1] ""
## [1] "Simulation 44"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.1506666 3.4014931 3.2602878 2.6512652 1.9423619 0.6917336 0.4675189
## [1] ""
## [1] "Simulation 45"
## [1] "Delta = 5"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.2679171 1.8542081 1.4824850 2.0646809 3.9834591 0.8459215 7.9667314
## [1] ""
## [1] "Simulation 46"
## [1] "Tested an infected person"
## [1] "Delta = 1"
## [1] "I" "E" "S" "R" "R" "S" "R"
## [1] "Number of iterations = 12"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 5"
## [1] "Duration of time each individual is infected:"
## [1] 0.9408945 0.0000000 0.0000000 0.9178704 0.3586447 0.0000000 0.5420222
## [1] ""
## [1] "Simulation 47"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.9026095 3.5964153 5.2816222 4.6696210 5.6442163 3.4479119 1.0313419
## [1] ""
## [1] "Simulation 48"
## [1] "Delta = 5"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"

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## [1] 4.343893 4.813156 10.733746 2.284148 7.928325 1.838897 8.795867
## [1] ""
## [1] "Simulation 49"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.5249830 1.1229683 2.7861388 2.1682966 2.5223187 0.8245688 7.7093367
## [1] ""
## [1] "Simulation 50"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 6.7893162 2.5796717 0.9319903 1.7953388 2.4474862 0.8086891 0.4371771
## [1] ""
## [1] "Simulation 51"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.5358124 0.2731307 2.5220037 1.3765455 0.5164693 2.6831637 1.3390372
## [1] ""
## [1] "Simulation 52"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 6.699679 3.600700 3.155383 3.199982 5.895469 1.391028 3.312789
## [1] ""
## [1] "Simulation 53"
## [1] "Tested an infected person"
## [1] "Delta = 2"
## [1] "R" "I" "R" "R" "R" "S" "R"
## [1] "Number of iterations = 18"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 6"
## [1] "Duration of time each individual is infected:"
## [1] 2.229416 1.845251 1.319259 2.809600 3.523400 0.000000 2.777469
## [1] ""
## [1] "Simulation 54"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"

```



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## [1] "Duration of time each individual is infected:"
## [1] 3.6723447 3.1401587 3.1599360 5.9181606 1.4064923 2.2928289 0.9109253
## [1] ""
## [1] "Simulation 55"
## [1] "Delta = 2"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 21"
## [1] "1 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 2.5403983 2.5648318 2.9106929 3.8713049 0.7018995 2.8911223 3.0766662
## [1] ""
## [1] "Simulation 56"
## [1] "Tested an infected person"
## [1] "Delta = 2"
## [1] "S" "I" "R" "R" "E" "R" "S"
## [1] "Number of iterations = 13"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 5"
## [1] "Duration of time each individual is infected:"
## [1] 0.0000000 1.9633591 1.9787006 0.8929955 0.0000000 1.3768866 0.0000000
## [1] ""
## [1] "Simulation 57"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 1.573578 4.849755 2.607765 2.272137 1.318653 1.101981 2.761591
## [1] ""
## [1] "Simulation 58"
## [1] "Delta = 5"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 24"
## [1] "4 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 0.2185017 3.4185718 1.0408293 1.4216274 1.3268991 2.0911136 4.0921069
## [1] ""
## [1] "Simulation 59"
## [1] "Delta = 4"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 23"
## [1] "3 people were tested"
## [1] "Number of individuals Exposed or higher = 7"
## [1] "Duration of time each individual is infected:"
## [1] 7.447167 2.514331 5.915428 3.166566 8.032432 3.687977 12.910472
## [1] ""
## [1] "Simulation 60"
## [1] "Delta = 3"
## [1] "R" "R" "R" "R" "R" "R" "R"
## [1] "Number of iterations = 22"
## [1] "2 people were tested"

```

```
## [1] "Number of individuals Exposed or higher = 7"  
## [1] "Duration of time each individual is infected:"  
## [1] 0.5292639 0.7286261 0.2365106 1.9864446 7.9666851 2.2175999 3.9537787  
## [1] ""
```

```
# Seems like the mean number of iterations till program ends is 22.
```

```
#### System.time result ~= 0.1 seconds ####
```

```
## Could try supply for next draft.
```