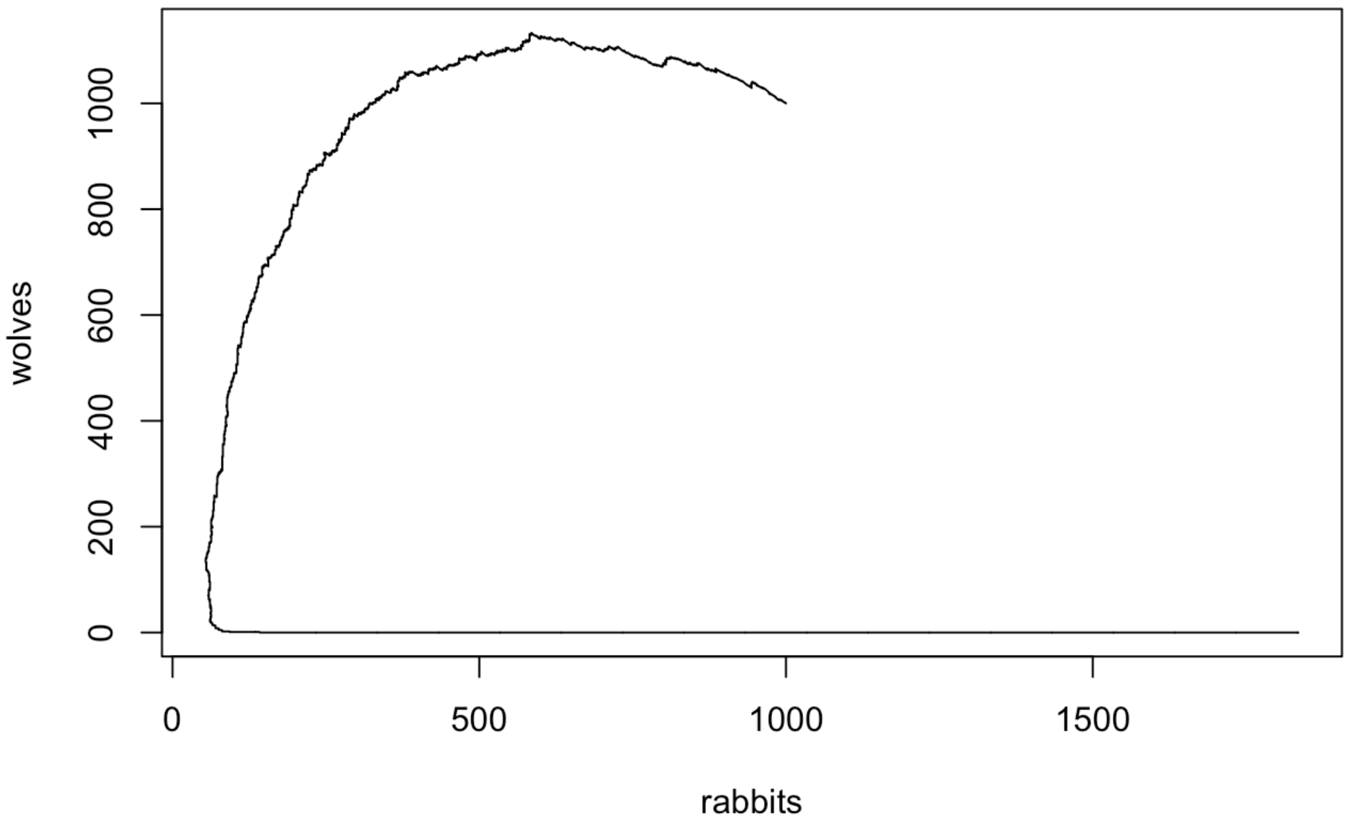
HW#2

#1 Wolf Population dies out

```
x1 <- 1000 #start with a poluation of 1000 rabbits
x2 <- 1000 #start with a population of 1000 wolves
steps = 5000

rabbits <- rep(0, steps)
wolves <- rep(0, steps)
step <- rep(0, steps)

# We define our b, d, q > 0, so that the wolf population dies out
b <- 5
d <- 30
q <- 0.05

for(i in c(1:steps)){

  bRab <- ((b*x1)/((b*x1) + (d*x2) + (q*x1*x2))) #transition prob. of rabbit being bo
rn (birth rate)
  dRbW <- ((q*x1*x2)/((b*x1) + (d*x2) + (q*x1*x2))) #transition prob. of a rabbit eat
en and a new wolf born
  dWolf <- ((d*x2)/((b*x1) + (d*x2) + (q*x1*x2))) #transition prob. of wolf dying of
hunger (death rate)

  rabbits[i] <- x1
  wolves[i] <- x2

  result <- sample(c('x1', 'x1x2', 'x2'), size = 1, replace = FALSE, prob = c(bRab, d
RbW, dWolf))
  step[i] <- result

  if(result == 'x1'){ #a rabbit is born and added to the population
    x1 <- x1+1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }

  else if(result == 'x1x2'){ #a rabbit dies and is taken from the population and a wo
lf is born and added to the population
    x1 <- x1-1
    x2 <- x2+1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }

  else{# if(result == 'x2'){ #a wolf dies of hunger and is taken from the population
```

```
    x2 <- x2 - 1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }
}

#c(rabbits, wolves)
plot(rabbits, wolves, type = 'l')
```



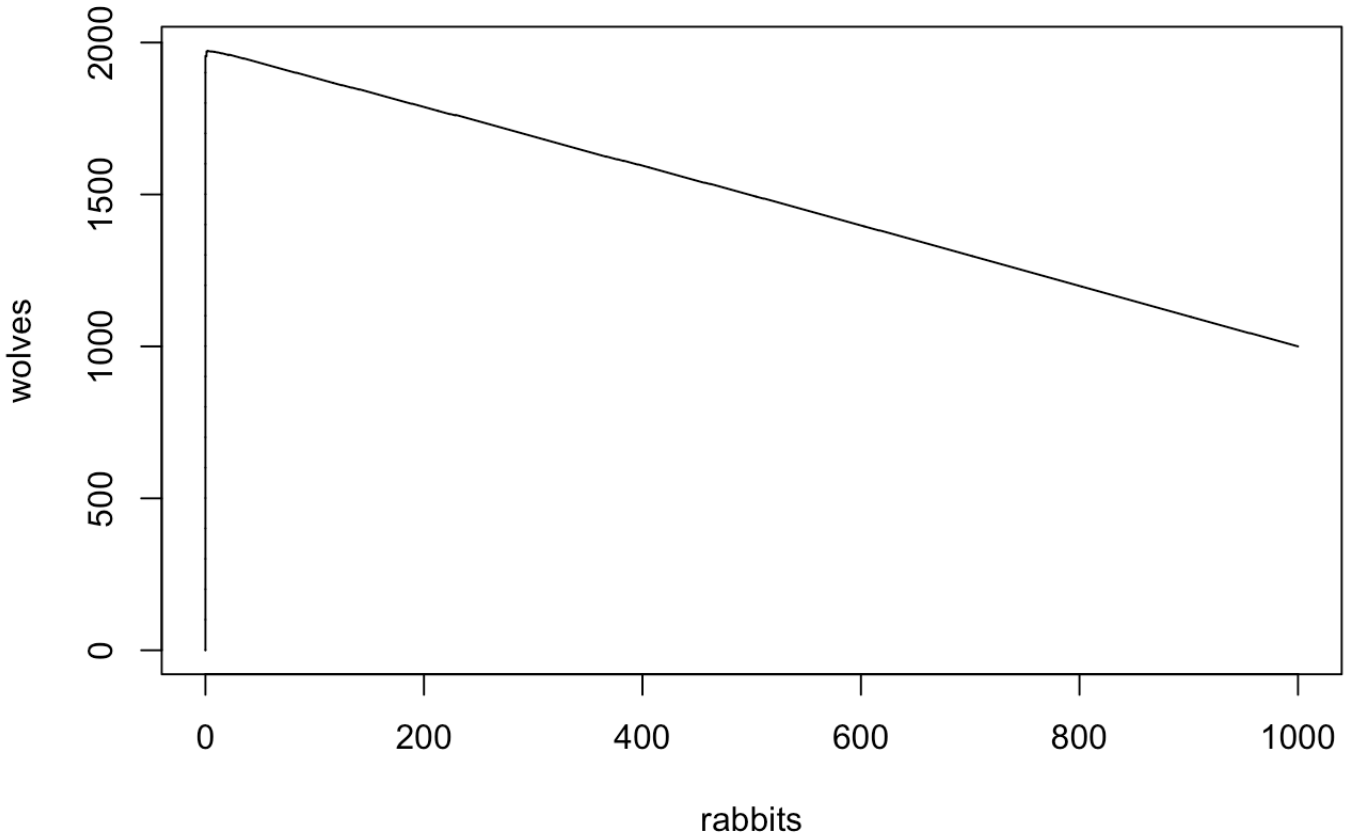
#

The wolf population will die out, and eventually, the rabbit population will constantly increase since there are no wolves to eat them.

#2 Rabbit population dies out

```
x1 <- 1000 #start with a poluation of 1000 rabbits
x2 <- 1000 #start with a population of 1000 wolves
steps = 3000

rabbits <- rep(0, steps)
wolves <- rep(0, steps)
step <- rep(0, steps)

bRab <- c()
dRbW <- c()
```

```r
dWolf <- c()

# We define our b, d, q > 0, so that the rabbit population dies out
b <- 5
d <- 30
q <- 5

for(i in c(1:steps)){

  bRab[i] <- ((b*x1)/((b*x1) + (d*x2) + (q*x1*x2)))
  dRbW[i]<- ((q*x1*x2)/((b*x1) + (d*x2) + (q*x1*x2)))
  dWolf[i] <- ((d*x2)/((b*x1) + (d*x2) + (q*x1*x2)))

  rabbits[i] <- x1
  wolves[i] <- x2

  result <- sample(c('x1', 'x1x2', 'x2'), size = 1, replace = FALSE, prob = c(bRab[i]
, dRbW[i], dWolf[i]))
  step[i] <- result

  if(result == 'x1'){
    x1 <- x1+1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }

  else if(result == 'x1x2'){
    x1 <- x1-1
    x2 <- x2+1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }

  else{# if(result == 'x2'){
    x2 <- x2 - 1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }
}

#c(rabbits, wolves)
plot(rabbits, wolves, type = 'l')
```

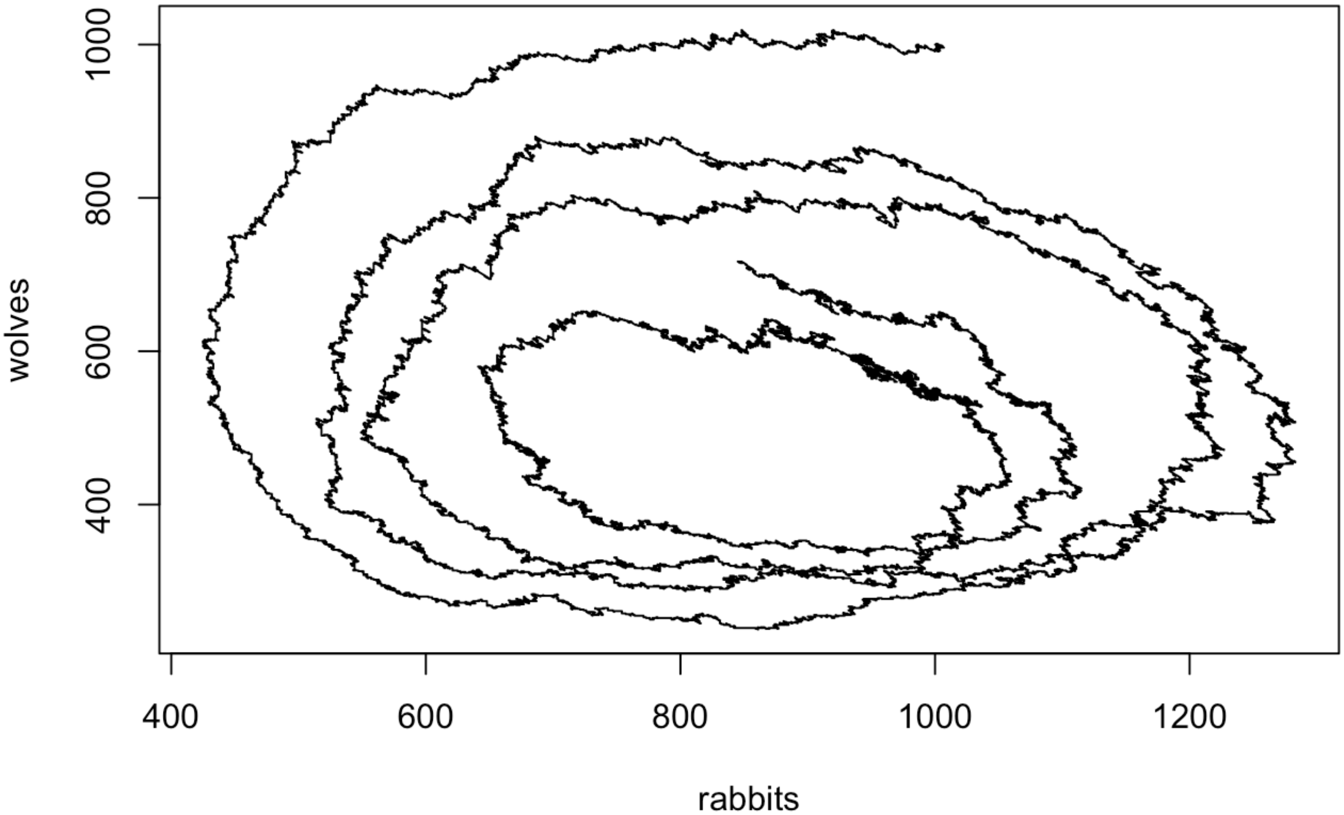


#

The rabbit population dies off, and eventually the wolves will die off as well since they will have nothing to eat.

#3 Both populations move up and down together

```r
x1 <- 1000 #start with a poluation of 1000 rabbits
x2 <- 1000 #start with a population of 1000 wolves
steps = 50000

rabbits <- rep(0, steps)
wolves <- rep(0, steps)
step <- rep(0, steps)

# We define our b, d, q > 0, so that the populations of rabbits and wolves move up an
d down together.
b <- 150
d <- 250
q <- 0.3

for(i in c(1:steps)){

  bRab <- ((b*x1)/((b*x1) + (d*x2) + (q*x1*x2)))
  dRbW <- ((q*x1*x2)/((b*x1) + (d*x2) + (q*x1*x2)))
  dWolf <- ((d*x2)/((b*x1) + (d*x2) + (q*x1*x2)))

  rabbits[i] <- x1
  wolves[i] <- x2

  result <- sample(c('x1', 'x1x2', 'x2'), size = 1, replace = FALSE, prob = c(bRab, d
RbW, dWolf))
  step[i] <- result

  if(result == 'x1'){
    x1 <- x1+1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }

  else if(result == 'x1x2'){
    x1 <- x1-1
    x2 <- x2+1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }

  else{# if(result == 'x2'){
    x2 <- x2 - 1
    rabbits[i+1] <- x1
    wolves[i+1] <- x2
  }
}

#c(rabbits, wolves)
plot(rabbits, wolves, type = 'l')
```



#

The population of rabbits and wolves are both dying and being born, so they are moving up and down together in a circlular manner.