Exercise 2.1 - Survey of ecological models, Part 1

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Instructions

Create either an R script (.R file) or R Markdown document (.Rmd) to save all of your work for today.

Exercise 1. Refresh your memory / repeat from last exercise

1. We will learn to write our own function - see my example here: I create a function called `my_fun`, which takes two values (x and y), adds them together, and returns the added value.

```
my_fun <- function(x, y) {
    z <- x + y
    return(z)
}
my_fun(17, 3)
```

```
## [1] 20
```

Please choose two numbers for x and y, and use them to execute `my_fun(x,y)`.

2. Your turn! Write a function called `times_seven` - it should take a single argument, multiply that value by 7, and return the new value.

3. See the `for` loops I have written below:

```
# note how the loop changes the value of the variable x for
# each iteration of the loop: first x=1 and 'print(x)' is
# executed. Then x=2, then x=3, and so on.
for (x in 1:5) {
    print(x)
}
```

```
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
```

```r
for (i in 1:5) {
    z <- i + 6
    print(z)
}
```

```
## [1] 7
## [1] 8
## [1] 9
## [1] 10
## [1] 11
```

```r
a <- rep(NA, 5)
for (i in 1:5) {
    a[i] <- i
}
a
```

```
## [1] 1 2 3 4 5
```

```r
b <- c("I", "love", "R")
for (i in 1:length(b)) {
    print(b[i])
}
```

```
## [1] "I"
## [1] "love"
## [1] "R"
```

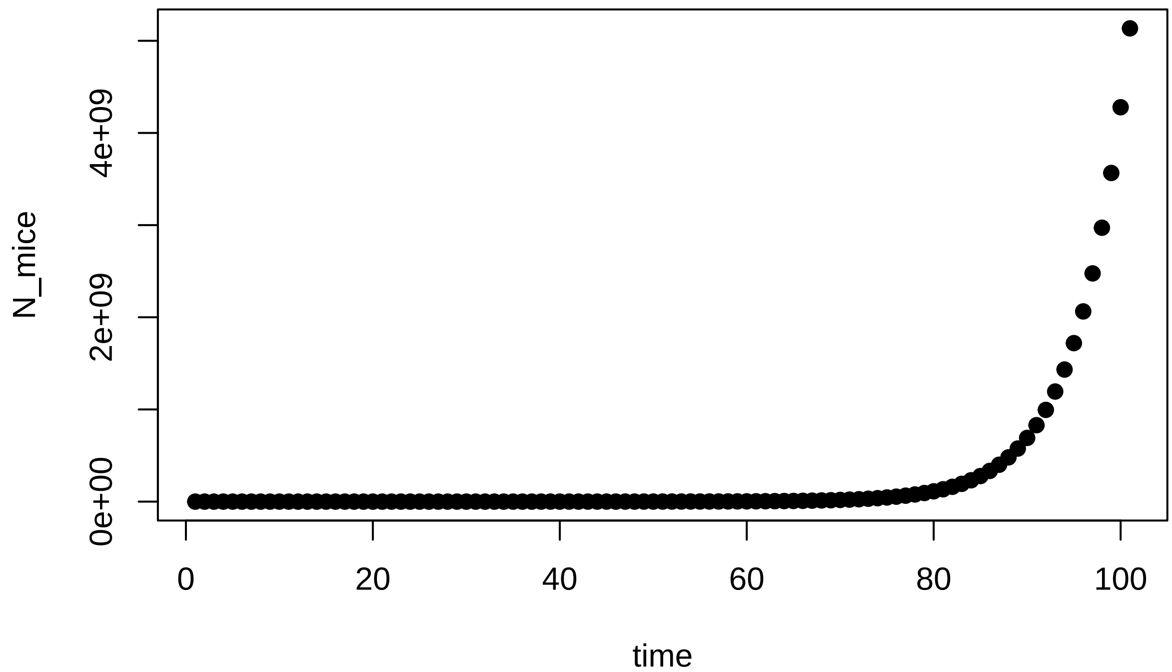
Your turn - For each of three values of volume, `v <- c(1.6,3,8)`, calculate the *mass*, where `m <- 2.65 * volume ^ 0.9`. Please calculate this in a loop. You can print the values within the loop.

Exercise 2. Use functions, for loops, and plotting skills to run simulation of mice in the yard

I built a function to calculate the number of mice in a yard using equation 2.4 from **Otto & Day Ch2**:

```r
mice <- function(Nt,d,b,m){
  Nt1 <- (1+b)*(1-d)*Nt + m
  return(Nt1)
}
```

4. I would like you to create the following plot of mouse population size (N) over time, using the following values for parameters: $d = 0.7$, $b = 3$, $m = 4$, $N_t = 42$.



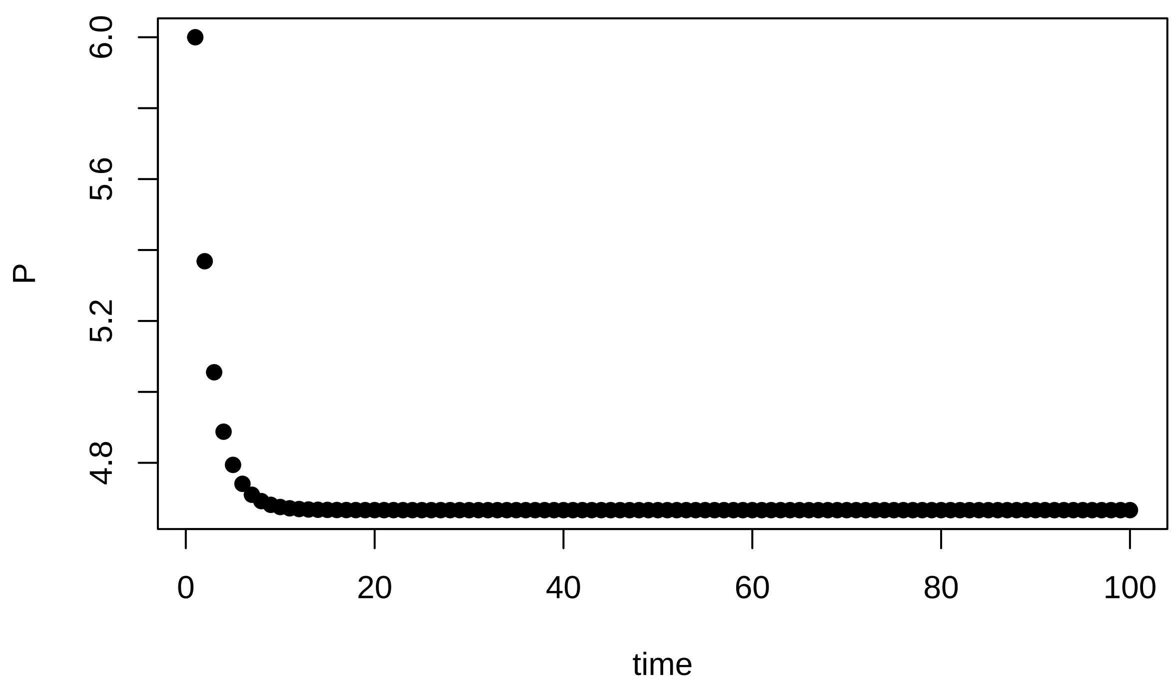
To do this, you should approach the problem in a few steps:

- Step 1. Save d, b, m, and N_t as their own variables.
- Step 2. Write the *mice* function.
- Step 3. Make sure the function works by calling it one time using the values given in Step 1. It should return a value for $N_{t+1} = 54.4$.
- Step 4. Create a new variable called N, which can hold the values generated by the function.
- Step 5. Write a *for* loop that will take the calculated value of N_{t+1}, and use it as the next time step's value of N_t. Repeat this for $i = 100$ time steps.
- Step 6. Use R's *plot* function (or you can use ggplot if you like) to plot N over time.

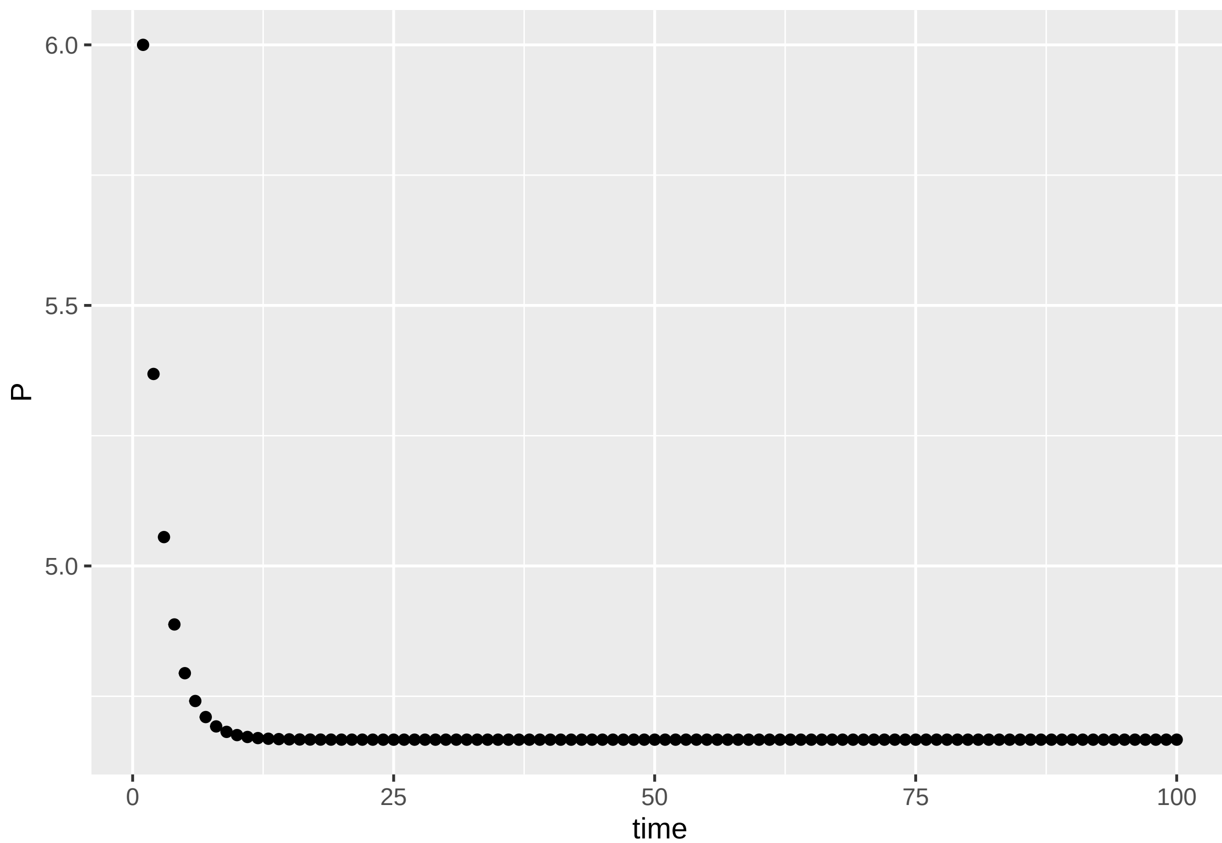
I demonstrate how this can work below. I use a different function as an example, $P(t+1) = \frac{bP(t)}{1+cP(t)}$:

```
# Step 1. Example parameters
b <- 1.7
c <- .15
Pt <- 6

# Step 2. Example equation function
example_equation_function <- function(b,c,Pt){
  Pt1 <- (b*Pt) / (1 + c*Pt)
  return(Pt1)
}

# Step 3. Make sure the function works
Pt1 <- example_equation_function(b,c,Pt)
```

```r
# Step 4. Create a new variable to hold future values of P
P <- rep(NA,100)

# Step 5. Create a for loop to iteratively calculate P
P[1] <- Pt
for(i in 2:100){
  P[i] <- example_equation_function(b,c,Pt)
  Pt <- P[i]
}

# Step 6. Plot P over time
plot(P,xlab="time",ylab="P",pch=19,col="black")
```




```r
dat <- as.data.frame(P)
dat$time <- as.numeric(rownames(dat))
library(ggplot2)
ggplot2::ggplot(dat,aes(time,P)) + geom_point()
```



Exercise 3. Use functions, for loops, and plotting skills to run simulation of exponential population growth

5. Please use the following simulation for exponential population growth in discrete time, $ n_{t+1} = Rn(t)$, to create the below plot of population size (n) over time (t). Use the following values for parameters: $R = 1.7$, $N_0 = 42$. Evaluate this for 100 time steps.

```
## Step 1. Write values for the parameters in the model
## (and initial values of state variables) R - the
## population growth rate, expressed as the number of
## individuals that replace an individual in the population
## (where R=1 is each individual replacing itself, and
## therefore no change in population size over time) --> N
## (-infinity - infinity)
R <- 1.7
# N0 - the initial population size
N0 <- 42

## Step 2. Write a function that will calculate values of
## number of individuals from one time step to the next.
disc_exp <- function(R, N0) {
    Nt1 <- R * N0
    return(Nt1)
}
```

```r
## Step 3. Call the function disc_exp(R,N0)

## Step 4. Follow the population size over some time
## intervals N - a variable where we record the population
## size over time
N <- N0

for (i in 1:100) {
    Nt1 <- disc_exp(R, N0)
    N <- c(N, Nt1)
    N0 <- Nt1
}
```