Lab 03

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1

Come up with a system of equations with 3 unknowns and 3 equations (in contrast to the example with 2 unknowns and 2 equations) and solve it.

```
A <- rbind(c(1,5,7), c(8,3,8), c(5,7,2))
b <- c(9,3,1)
x <- solve(A,b)
print(x)
```

```
## [1] -0.8795518  0.4621849  1.0812325
```

2

Solve the following differential equation exactly as was done in the example. You may do it by hand or with code:

$$\frac{dx}{dt} = \alpha x^2$$

$$\int dx \, \frac{1}{x^2} = \int \alpha \, dt$$

$$\frac{1}{-2+1} x^{-2+1} = \alpha t$$

$$-x^{-1} = \alpha t$$

$$-\frac{1}{x} + c = \alpha t$$

plug in $x(0) = 1$

$t = 0$

$x = 1$

$$-\frac{1}{1} + c = 0$$

$$c = 1$$

3

Write code that models the predator-prey relationship (Lotka-Volterra model).

```
func3 <- function(time3, state3, parameters3){
  # c in the equation in the lab_03 paper is actually k
  dV = parameters3['r']*state3['V']-parameters3['k']*state3['V']*state3['P']
  dP = parameters3['e']*parameters3['k']*state3['V']*state3['P'] - parameters3['d']*s
tate3['P']
  # return(c(list(dV),list(dP)))
  return(list(c(dV,dP)))
}
```

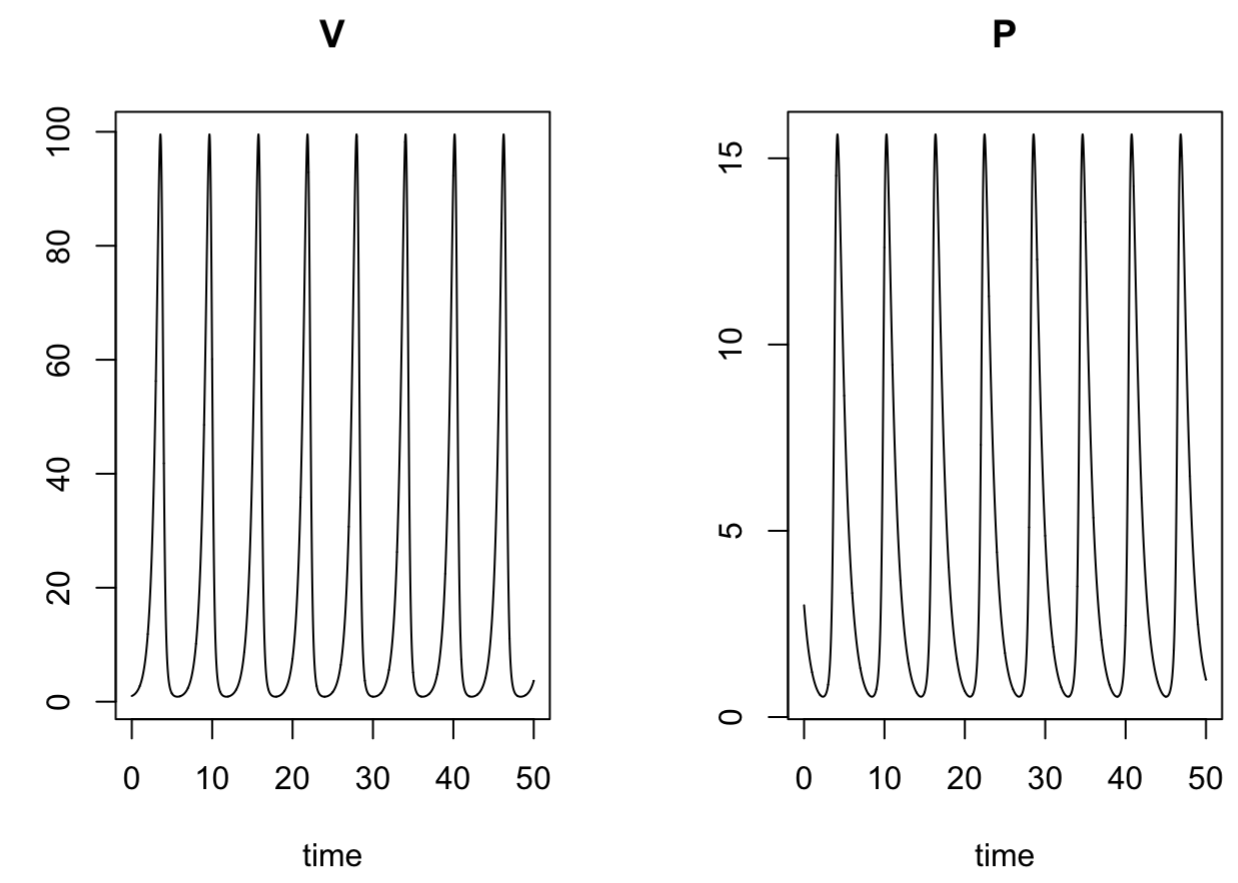
4

Solve it with the following parameters and plot the results: r = 1.8, k = 0.4, e = 0.12, d = 1

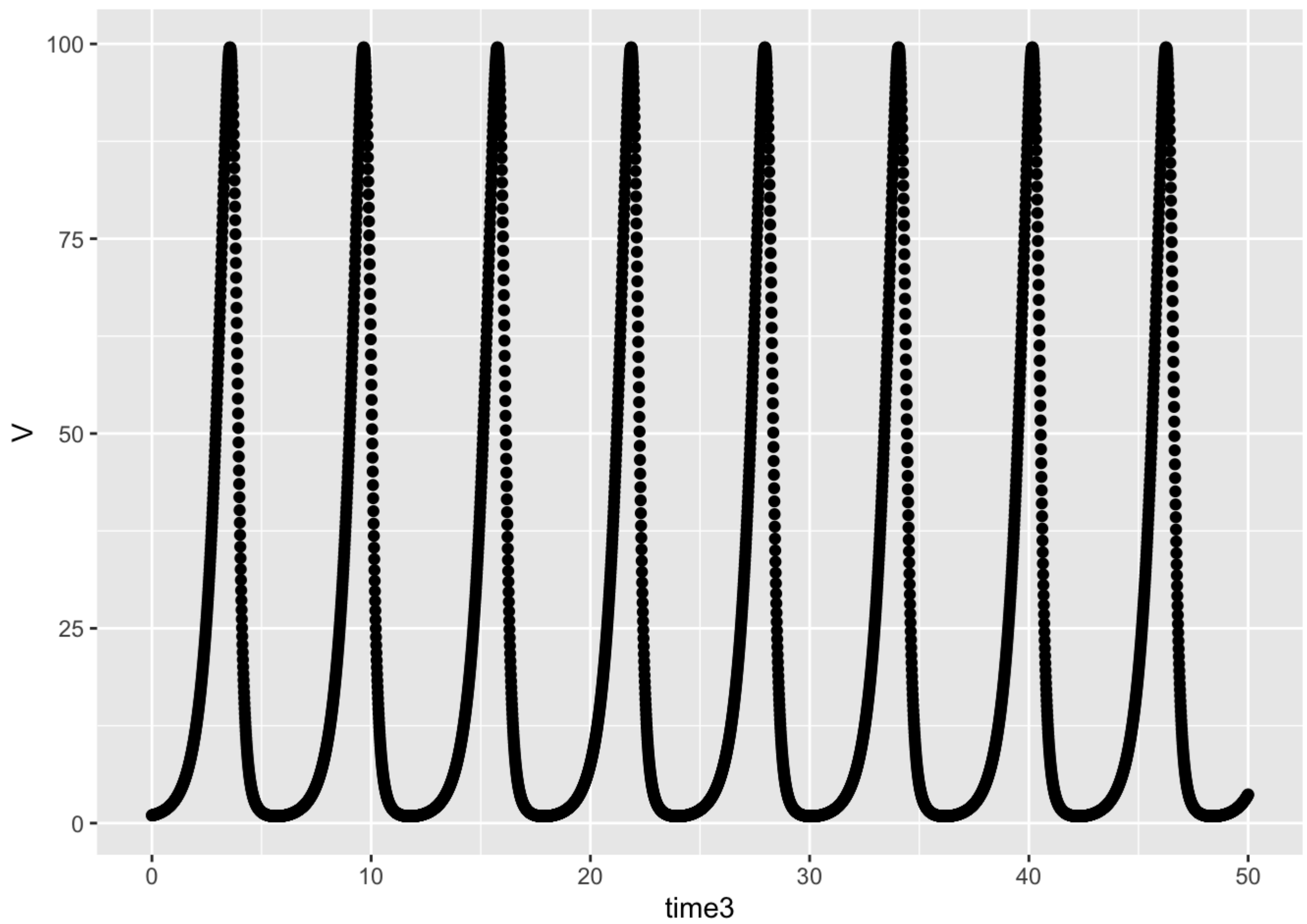
```
time3 <- seq(from=0, to=50, by=0.01)
parameters3 <- c(r=1.8, k=0.4, e=0.12, d=1)
state3 <- c(V=1, P=3)  # just try some numbers

# install.packages('deSolve',repos='http://probability.ca/cran')
library(deSolve)
output3 <- ode(y=state3, times=time3, func=func3, parms=parameters3)

plot(output3)
library(ggplot2)
```




```
q3_V <- ggplot(data=as.data.frame(output3),aes(time3,V)) + geom_point()
print(q3_V)
```




```
q3_P <- ggplot(data=as.data.frame(output3),aes(time3,P)) + geom_point()
print(q3_P)
```