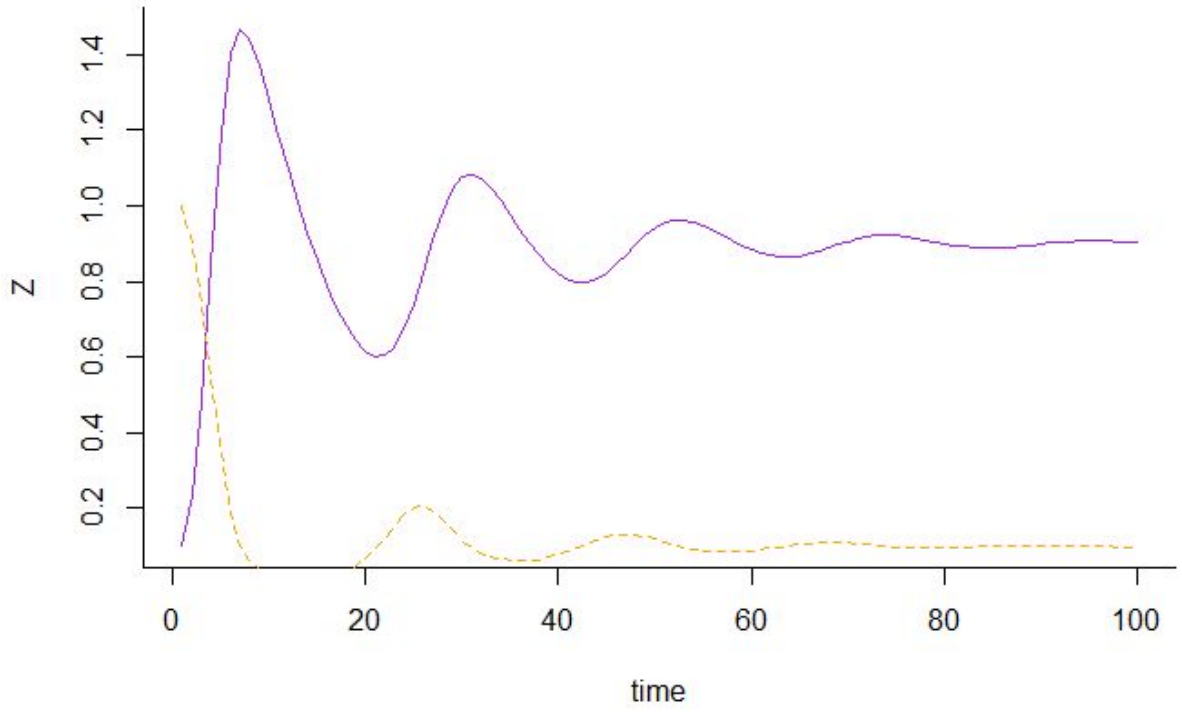
1C)

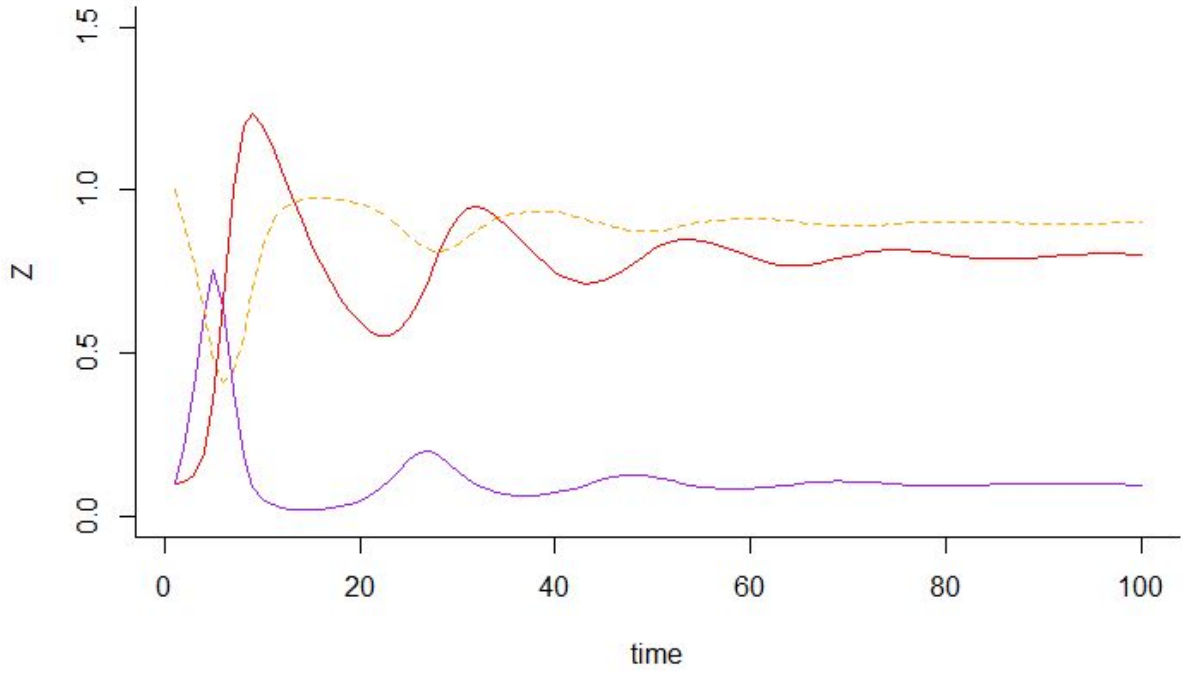


Purple: zombies, Orange: humans

```
## write a function for predator-prey
predprey <- function(t, y, p) {
  H <- y[1]
  Z <- y[2]
  with(as.list(p), {
    dH.dt <- ((r*H)*(1-(H/k))-(b*H*Z))
    dZ.dt <- ((c*H*Z)-(m*Z))
    return(list(c(dH.dt, dZ.dt)))
  })
}

## specify parameter values and initial conditions
p <- c('r' = 1, 'b' = 1, 'c' = 1, 'k' = 1, 'm' = 0.1)
y0 <- c('H' = 1, 'Z' = 0.1)
t <- 1:100

## simulations
```

```
sim <- ode(y = y0, times = t, func = predprey, parms = p,
          method = 'lsoda')
sim <- as.data.frame(sim)

## plot time series
plot(Z ~ time, data = sim, type = 'l', col = 'purple', bty = 'l')
points(H ~ time, data = sim, type = 'l', col = 'orange', lty = 2)


## plot phase space and attractor
plot(Z ~ H, data = sim, type = 'p', bty = 'l')
points(sim$Z[nrow(sim)] ~ sim$H[nrow(sim)], pch = 21,
       bg = 'red', cex = 2.5)
summary(sim)
  time             H                Z
 Min.   :  1.00   Min.   :0.01685   Min.   :0.1000
 1st Qu.: 25.75   1st Qu.:0.08586   1st Qu.:0.8641
 Median : 50.50   Median :0.09899   Median :0.9016
 Mean   : 50.50   Mean   :0.12657   Mean   :0.8972
 3rd Qu.: 75.25   3rd Qu.:0.10930   3rd Qu.:0.9307
 Max.   :100.00   Max.   :1.00000   Max.   :1.4675
```

2)




```
## write a function for predator-prey
predprey <- function(t, y, p) {
  H <- y[1]
  Z <- y[2]
  P <- y[3]
  with(as.list(p), {
    dH.dt <- ((r*H)*(1-(H/k))-(b*H*Z))
    dZ.dt <- ((c*H*Z)-(m*Z)-(d*Z*P))
    dP.dt <- ((e*Z*P)-(n*P))
    return(list(c(dH.dt, dZ.dt, dP.dt)))
  })
}

## specify parameter values and initial conditions
p <- c('r' = 1, 'b' = 1, 'c' = 1, 'k' = 1,
       'm' = 0.1, 'd' = 1, 'e' = 1, 'n' = 0.1)
y0 <- c('H' = 1, 'Z' = 0.1, 'P' = 0.1)
t <- 1:100

## simulations
sim <- ode(y = y0, times = t, func = predprey, parms = p,
           method = 'lsoda')
```

```
sim <- as.data.frame(sim)

## plot time series
plot(Z ~ time, data = sim, type = 'l', col = 'purple', ylim = c(0, 1.5), bty = 'l')
points(H ~ time, data = sim, type = 'l', col = 'orange', lty = 2)
points(P ~ time, data = sim, type = 'l', col = 'red', bty = 'l')
summary(sim)
```

```
time                      H                 Z                  P
 Min.   :  1.00   Min.   :0.4122   Min.   :0.02149   Min.   :0.1000
 1st Qu.: 25.75   1st Qu.:0.8910   1st Qu.:0.08714   1st Qu.:0.7665
 Median : 50.50   Median :0.9002   Median :0.09936   Median :0.7991
 Mean   : 50.50   Mean   :0.8808   Mean   :0.12076   Mean   :0.7769
 3rd Qu.: 75.25   3rd Qu.:0.9122   3rd Qu.:0.10891   3rd Qu.:0.8204
 Max.   :100.00   Max.   :1.0000   Max.   :0.75519   Max.   :1.2352
```