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##Jamie Campbell, Midterm Problem 3

library(deSolve)

log.growth <- function(t, y, p) {
  N <- y[1]
  with(as.list(p), {
    dN.dt <- r * N * (1 - (N / K)^theta)
    return(list(dN.dt))
  })
}

p <- c('r' = 0.2, 'K' = 1.05, 'theta' = 1.05)
p2<-c('r'=0.28, 'K' = 0.75, 'theta' = 1.25)
p3<-c('r'=0.15, 'K'=1.0, 'theta'=1.0)
y0 <- c('N' = 0.01)
t <- 1:100

sim <-ode(y =y0, times = t, func = log.growth, parms = p, method = 'lsoda')
sim2 <-ode(y=y0, times = t, func= log.growth, parms =p2, method = 'lsoda')
sim3 <-ode(y=y0, times = t, func= log.growth, parms =p3, method = 'lsoda')

sim <- as.data.frame(sim)
sim2 <- as.data.frame(sim2)
sim3 <- as.data.frame(sim3)

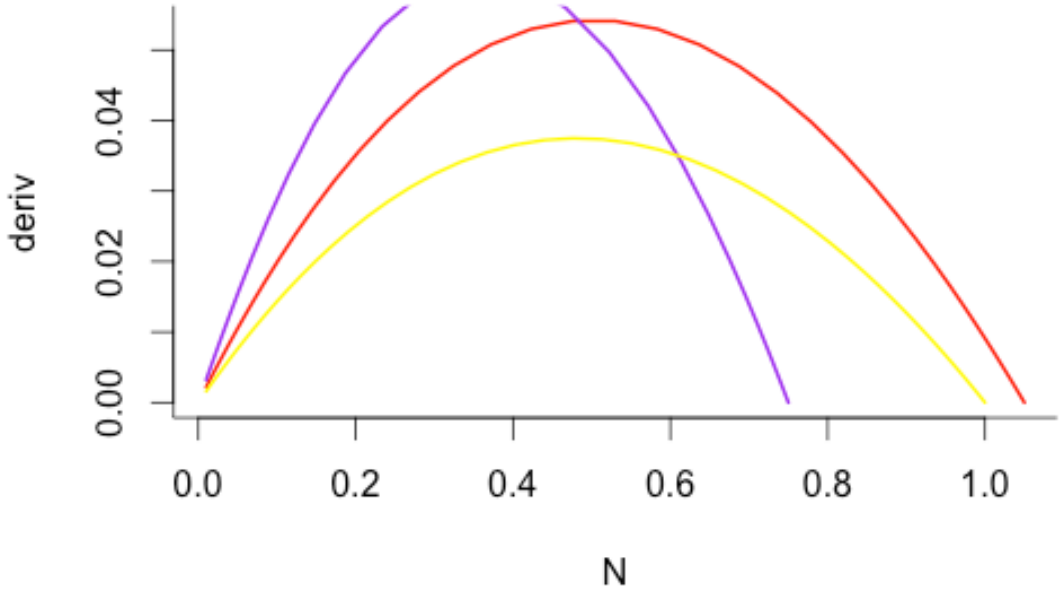
sim$deriv<-c(diff(sim$N), NA)
sim2$deriv<-c(diff(sim2$N), NA)
sim3$deriv<-c(diff(sim3$N), NA)

plot(deriv ~ N, data = sim, type ='l', lwd = 2, bty ='l', col = 'red')
lines(deriv ~ N, data = sim2, type ='l', lwd = 2, bty ='l', col = 'purple')
lines(deriv ~ N, data = sim3, type ='l', lwd = 2, bty ='l', col = 'yellow')

max(sim$deriv, na.rm = TRUE)
max(sim2$deriv, na.rm = TRUE)
max(sim3$deriv, na.rm = TRUE)

which(sim$deriv == max(sim$deriv, na.rm = TRUE))
which(sim2$deriv == max(sim2$deriv, na.rm = TRUE))
which(sim3$deriv == max(sim2$deriv, na.rm = TRUE))

sim$N[which(sim$deriv == max(sim$deriv, na.rm = TRUE))]
sim2$N[which(sim2$deriv == max(sim2$deriv, na.rm = TRUE))]
sim3$N[which(sim3$deriv == max(sim3$deriv, na.rm = TRUE))]
```


deriv
0.00
0.02
0.04
0.0
0.2
0.4
0.6
0.8
1.0
N