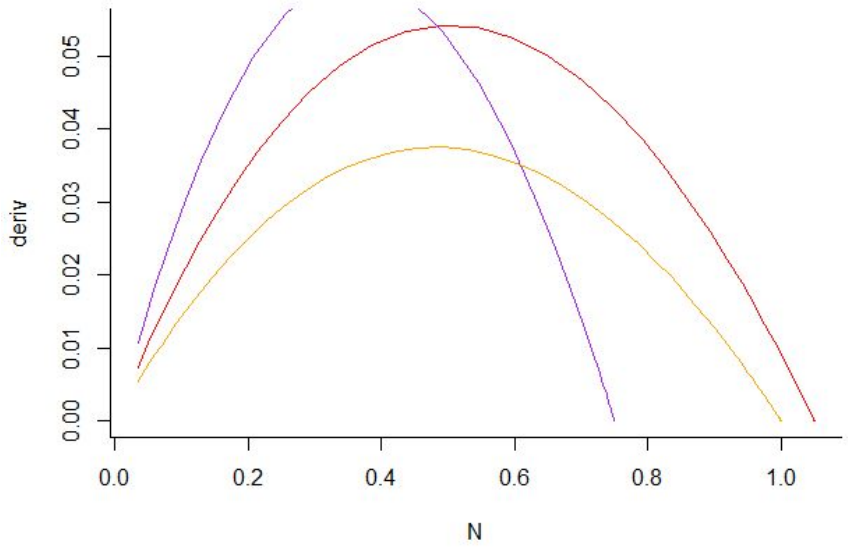
```
## exam #3

## theta log growth function
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))
  })
}

## parameters
p.1 <- c('r' = 0.2, 'K' = 1.05, 'theta' = 1.05)
y0 <- c('N' = runif(1, min = 0.01, max = 0.1))
t <- 1:100
p.2 <- c('r' = 0.28, 'K' = 0.75, 'theta' = 1.25)
y0 <- c('N' = runif(1, min = 0.01, max = 0.1))
t <- 1:100
p.3 <- c('r' = 0.15, 'K' = 1, 'theta' = 1)
y0 <- c('N' = runif(1, min = 0.01, max = 0.1))
t <- 1:100

## simulation
sim.1 <- ode(y = y0, times = t, func = log.growth, parms = p.1, method = 'lsoda')
sim.1 <- as.data.frame(sim.1)
sim.2 <- ode(y = y0, times = t, func = log.growth, parms = p.2, method = 'lsoda')
sim.2 <- as.data.frame(sim.2)
sim.3 <- ode(y = y0, times = t, func = log.growth, parms = p.3, method = 'lsoda')
sim.3 <- as.data.frame(sim.3)

## plot
plot(N ~ time, data = sim.1, type = 'l', lwd = 2, bty = 'l', col = 'red')
plot(N ~ time, data = sim.2, type = 'l', lwd = 2, bty = 'l', col = 'purple')
plot(N ~ time, data = sim.3, type = 'l', lwd = 2, bty = 'l', col = 'orange')


## compute derivatives
sim.1$deriv <- c(diff(sim.1$N), NA)
sim.2$deriv <- c(diff(sim.2$N), NA)
sim.3$deriv <- c(diff(sim.3$N), NA)

## plot vs pop abundance
plot(deriv ~ N, data = sim.1, type = 'l', col = 'red', bty = 'l')
```

```
points(deriv ~ N, data = sim.2, type ='l', col = 'purple', xlab = 'N', ylab = 'dN/dt', bty = 'l')
points(deriv ~ N, data = sim.3, type ='l', col = 'orange', xlab = 'N', ylab = 'dN/dt', bty = 'l')

##find abundance with highest growth rate
max(sim.1$deriv, na.rm = TRUE)
which(sim.1$deriv == max(sim.1$deriv, na.rm = TRUE))
0.05421185, 17
max(sim.2$deriv, na.rm = TRUE)
which(sim.2$deriv == max(sim.2$deriv, na.rm = TRUE))
 0.06078995, 11
max(sim.3$deriv, na.rm = TRUE)
which(sim.3$deriv == max(sim.3$deriv, na.rm = TRUE))
0.03746907, 23
```



Based on the graph I plotted above and the calculation of the abundance with the highest growth rate, the farmer should consider growing crops of grapes to maximize his revenue.