HW1 - SARAH WARD

① $\frac{\ln[N(t)/N(0)]}{r} = t$

$N(0) = 10 \quad r = 0.1 \quad N(t) = 100$
1000
100 000 000
100 000 000 000

$t = \frac{\ln[100/10]}{0.1} = \boxed{23.026}$ when $N(t) = 100$

$t = \frac{\ln[1000/10]}{0.1} = \boxed{46.052}$ when $N(t) = 1000$

$t = \frac{\ln[100\,000\,000/10]}{0.1} = \boxed{161.181}$ when $N(t) = 100{,}000{,}000$

$t = \frac{\ln[100{,}000{,}000{,}000/10]}{0.1} = \boxed{230.259}$ when $N(t) = 100{,}000{,}000{,}000$

Not surprising, it takes 2x the time to increase by a factor of 10^2 than it takes for the population to increase by a factor of 10^1.

Population ↑ of $10^{10} = 10t$ if t is time it takes to increase by a factor of 10^1
eg. exponential growth.

② $\frac{\ln[N(t)/N(0)]}{r} = t, \quad t = 50 \quad N(50) = 2N(0) \quad N(0) = 6{,}900{,}000{,}000$

$r = \frac{\ln[2N(0)/N(0)]}{t} = \frac{\ln[N(0)]}{t} = \frac{\ln[6900000000]}{50} = 0.453$

OVER

$$N(t) = N(0)e^{rt}$$

so, $t = 41$ $N(0) = 6900000000$ $r = 0.453$

$$N(41) = 690000000 \cdot e^{[(0.453)(41)]}$$

$$= (690000000)(116453196.096)$$

$$N(41) = \boxed{8.0352705 \times 10^{17}}$$

③ $N_T = N_0 \lambda^T$ $\lambda = 1.12$ $N_T = 2N_0$ $T = ?$

$$\frac{N_T}{N_0} = \lambda^T$$

$$\ln\left(\frac{N_T}{N_0}\right) = T \ln\lambda$$

$$T = \frac{\ln\left(\frac{N_T}{N_0}\right)}{\ln\lambda} \quad T = \frac{\ln\left(\frac{2N_0}{N_0}\right)}{\ln(1.12)} = \frac{\ln(2)}{\ln(1.12)} = \frac{0.693147}{0.113329}$$

$T = 6.1162$ years (approx. doubling time)

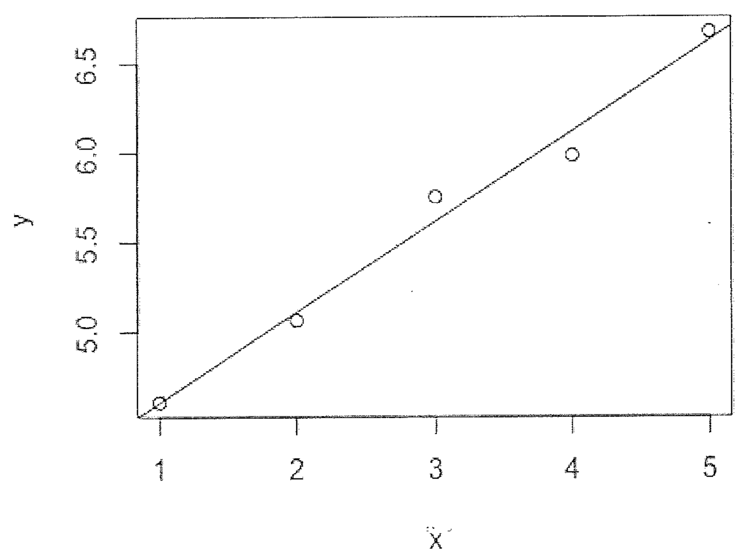
④ • human death rate in eugene is not significantly density dependent. There is enough space & enough resources that as of now, the average causes of death are not a direct result of population density.

- flu season – ↑ people = ↑ rate of transmission = ↑ liklihood of death as a result
- vehicle accidents – ↑ people = ↑ vehiles = ↑ higher rate of accidents = ↑ liklihood of death
- air pollution – ↑ people = ↑ industry = ↑ air pollution = ↑ rate of death caused by pollution

⑤ Apple flea weevils (Rhynchaeus pallicornis)

1 generation/year = discrete. This organism only reproduces once per year. It emerges in early spring, breeds, lays its larvae in leaves of apple trees, and enters diapause in August or september.

```
#hw1 question 6 - sarah ward

times <- 1:5
N <- log(c(100, 158, 315, 398, 794))
lm(y ~ x, data = z)$coefficients

y <- N
x <- times

lm(y ~ x)$coefficients

# evaluating lm(y ~ x)$coefficients returns:
 #(Intercept) = 4.0964696
 # x = 0.5067684


# X = r = 0.506784

plot (x,y)

?abline

abline (4.0964696, 0.5067684)
```



```
#hw1-7 sarah ward

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

p <- c('r' = 0.25)
y0 <- c('N' = 1)
t <- 1:100

install.packages ('deSolve')
library (deSolve)
?ode

#creating data using dN/dt formula and then making data frames for differnet r
variables
sim <- ode(y = y0, times = t, func = exp.growth, parms = p, method = 'lsoda')

head(sim)
class(sim)
sim.frame <- as.data.frame(sim)

p <- c('r' = 0.33)

sim2 <- ode(y = y0, times = t, func = exp.growth, parms = p, method = 'lsoda')

head(sim2)
class(sim2)
sim2.frame <- as.data.frame(sim2)

p <- c('r'= .02)


sim3 <- ode(y = y0, times= t, func = exp.growth, parms = p, method = 'lsoda')

head(sim3)
class(sim3)
sim3.frame <- as.data.frame(sim3)

#naming variables/vectors for each data frame

names(sim.frame)
```

```
names(sim.frame) <- c('t', 'abundance')
sim.frame$t
sim.frame$abundance

names(sim2.frame)
names(sim2.frame) <- c('t', 'abundance')
sim2.frame$t
sim2.frame$abundance

names(sim3.frame)
names(sim3.frame) <- c('t', 'abundance1')
sim3.frame$t
sim3.frame$abundance1

#attempt to plot...


install.packages ('ggplot2')

?plot

time <- sim.frame$t
abundance1 <- sim.frame$abundance
abundance2 <- sim2.frame$abundance
abundance3 <- sim3.frame$abundance

?points

points (t ~ abundance, data = totalsim,)


#I've been trying to get this data plotted for hours with no avail.
```