

MR

1. A population F_t of fruitflies (*Drosophila*) depends on time t . The initial population is $F_0 = 1000$ flies. The population is censused once every two (2) weeks. Over this period the natural rate of increase is 0.8%. At each census 40 flies are removed from the population and sacrificed for genetic analysis.

0.8 is 8%
0.08 is 8%
0.008 is 0.8%

- a. If r is the natural or intrinsic rate of increase then numerically (decimal form, not percent), $r = 0.008$.
- a. Write a difference equation that expresses this process (assume a discrete model). Your model equation should tell us how to compute the change in F .

$$\Delta F_n = F_{n+1} - F_n = 0.008 F_n - 40$$

only one of these is needed

say what the amount of change is (the process)

- b. Rewrite your equation in updating form, or do this from scratch from the information provided.

$$F_{n+1} = F_n + 0.008 F_n - 40$$

or $F_{n+1} = (1.008) F_n - 40$

- c. Compute the population after one month (4 weeks). Be careful! Should you compute F_4 or something else?

4 weeks is two censuses.

At 2 weeks we have $F_1 = (1.008) F_0$
 $= 968$

At 4 weeks we have

$$F_2 = (1.008) F_1 - 40$$

(over →) 935.744 to be exact.

$$= 975.6 - 40 \approx 936 \text{ whole flies}$$

See over

Note: we do not have a direct formula!

$\frac{d}{dt}$ always means of something, or mathematically, times something.

2. During the 1980's Costa Rica had the highest deforestation rate in the world at 2.9% per year. Deforestation (meaning loss of forested land) is a continuous process.

If $F(t)$ is the amount of forested land, write the model equation for this process.

The LHS (left hand side) of a continuous model

$$\frac{dF}{dt} = -0.029F$$

derivative is negative so F is decreasing

b. Give the explicit solution to this equation.

Equation

$$F(t) = F_0 e^{-0.029t} \quad (\text{loss of forested land})$$

is always a derivative

- c. (bonus) If $F(0)$ represents the amount of forested land in 1980, what percent was forested in 1990?

$$\begin{aligned} F(10) &= F_0 e^{(-0.029)(10)} \\ &= F_0 e^{-0.29} \\ &= 0.748 F_0 \end{aligned}$$

74.8% is still forested.

Qw 1(c) $F_2 = (1.008)^2 F_0 - 80$ is not correct, even though numerically this comes very close (936.064 also rounds to 936). Actually $F_2 = (1.008)^2 F_0 - (1.008)(40) - 40$ and the formula just gets worse and worse past $n=2$.