

12. (Gorilla poaching)

A gorilla population in the wild naturally reproduces at a rate proportional to how many gorillas there are, suggesting that if we treat the number of gorillas as a discrete variable, then the following difference equation could model the rate of change in their population size:

$$\Delta G = G_{n+1} - G_n = kG_n$$

However, it is known that poachers are killing gorillas. If we assume that they are being killed at a constant rate, then the following difference equation would take that poaching into account:

$$\Delta G = G_{n+1} - G_n = kG_n - p$$

Below are some data giving, for several different years, the size of the gorilla population in an African park known to be a location where poachers are active.

Year	Number of Gorillas
0	283
2	277
4	269
6	261
8	252
10	242
12	230

Your mission:

1. Use the given data to estimate the parameters k and p in the differential equation.
2. It is known that linear discrete dynamical models of this type, $G_{n+1} = (1+k)G_n - p$, have a general solution of the form

$$G_n = (1+k)^n G_0 - \frac{\left((1+k)^n - 1\right)}{k} p$$

3. Find the equilibrium for the general linear discrete dynamical model. Your answer should depend on k and p .
4. Superimpose a plot of the data in the table with a graph of the solution.
5. What is the long term population of gorillas with this value of p ? Is there any value of p that will not end in extinction?