

**TODOS OS EXERCÍCIOS PODEM SER RESOLVIDOS UTILIZANDO O RESULTADO**

The solution of the dynamical system  $a_{n+1} = ra_n + b, r \neq 1$  is

$$a_k = r^k c + \frac{b}{1-r}$$

for some constant  $c$  (which depends on the initial condition).

$$c = a_0 - \frac{b}{1-r} = a_0 - a^*$$

**Atenção para a identificação correta de cada parâmetro a partir do enunciado dos exercícios**



2. You are considering a 30-year mortgage that charges 0.4% interest each month to pay off a \$250,000 mortgage.
  - a. Determine the monthly payment  $p$  that allows the loan to be paid off at 360 months.
  - b. Now assume that you have been paying the mortgage for 8 years and now have an opportunity to refinance the loan. You have a choice between a 20-year loan at 4% per year with interest charged monthly and a 15-year loan at 3.8% per year with interest charged monthly. Each of the loans charges a closing cost of \$2500. Determine the monthly payment  $p$  for both the 20-year loan and the 15-year loan. Do you think refinancing is the right thing to do? If so, do you prefer the 20-year or the 15-year option?



11. Cipro is an antibiotic taken to combat many infections, including anthrax. Cipro is filtered from the blood by the kidneys. Each 24-hour period, the kidneys filter out about one third of the Cipro that was in the blood at the beginning of the 24-hour period.
- Assume a patient was given only a single 500-mg dose. Use a difference equation to construct a table of values listing the concentration of Cipro in this patient's blood at the end of each day.
  - Now assume that the patient must take an additional 500 mg per day. Use a difference equation to construct a table of values listing the concentration of Cipro at the end of each day.
  - Compare and interpret these two tables.
  - (extra) Qual a concentração de equilíbrio para a dose diária de 500 mg?
  - (extra) Qual deveria ser a dose diária para que a concentração no sangue atingisse 650 mg após 1 semana?
  - (extra) Qual é a concentração de equilíbrio para a dose diária encontrada no item (e).



4. *Mercury in Fish*—Public officials are worried about the elevated levels of toxic mercury pollution in the reservoirs that provide the drinking water to your city. They have asked for your assistance in analyzing the severity of the problem. Scientists have known about the adverse affects of mercury on the health of humans for more than a century. The term *mad as a hatter* stems from the nineteenth-century use of mercuric nitrate in the making of felt hats. Human activities are responsible for most mercury emitted into the environment. For example, mercury, a by-product of coal, comes from the smokestack emissions of old, coal-fired power plants in the Midwest and South and is disseminated by acid rain. Its particles rise on the smokestack plumes and hitch a ride on prevailing winds, which often blow northeast. After colliding with mountains, the particles drop to earth. Once in the ecosystem, microorganisms in the soil and reservoir sediment break down the mercury and produce a very toxic chemical known as methyl mercury.

Mercury undergoes a process known as bioaccumulation. This occurs when organisms take in contaminants more rapidly than their bodies can eliminate them. Therefore, the amount of mercury in their bodies accumulates over time. Humans can eliminate mercury from their system at a rate proportional to the amount remaining. Methyl mercury decays 50% every 65 to 75 days (known as the half-life of mercury) if no further mercury is ingested during that time.

Officials in your city have collected and tested 2425 samples of largemouth bass from the reservoirs and provided the following data. All fish were contaminated. The mean value of the methyl mercury in the fish samples was  $0.43 \mu\text{g}$  (microgram) per gram. The average weight of the fish was 0.817 kg.

- Assume the average adult person (70 kg) eats one fish (0.817 kg) per day. Construct a difference equation to model the accumulation of methyl mercury in the average adult. Assume the half-life is approximately 70 days. Use your model to determine the maximum amount of methyl mercury that the average adult human will accumulate in her or his lifetime.
- You find out that there is a lethal limit to the amount of mercury in the body; it is 50 mg/kg. What is the maximum number of fish per month that can be eaten without exceeding this lethal limit?