

COSC 120: Class Exercise 10

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1. Suppose a population is governed by Malthusian growth with a growth rate r and initial population p_0 . Then the population at year $m + 1$ is given by:

$$p_{m+1} = p_m + rp_m \tag{1}$$

If a population starts initially with 500 people and has a growth rate of 25%, how many people will there be in 50 years? Plot the population from year 0 to year 25. At what year will the population reach 100,000? 1,000,000?

2. Suppose a population is governed by the Logistic Population Growth law:

$$P_{m+1} = (1 + r)P_m - \left(\frac{1 + r}{c}\right)P_m^2$$

where r is the growth rate, and p_0 the initially population, c : carrying capacity. The steady state for this model is $P_{ss} = \frac{rc}{1+r} = \frac{c}{1+1/r}$. A population is governed by the logistic growth law. The carrying capacity is 400,000 and the natural growth rate is 4%. If the population is 20,000 this year, what will the population be at the end of each of the next 5 years? What is the steady state population? What percentage of the carrying capacity is the steady state population. In general, is the steady state population greater than or less than that of the carrying capacity? Why? Plot the population for the next 50 years using python. In what year will the population be within 1000 of the steady state?

Now, experiment with starting the population at the steady state and above it. Also, consider the case where you start the initial population near the carrying capacity.