

BIO 480/680 Lab Exercise 7
Root finding methods
Due date: 04 April 2025

In this section of the course, we want to be able to develop models for interactions between organisms and their environment, specifically, energy-budget models that can predict the temperature of an organism given its surroundings. These models can be difficult to solve without the help of computers, and so before working directly with the biological models, we need to develop the ability to solve equations like those we will run into in the energy budget models.

Solving equations like the ones we will see in our energy-budget models involves a numerical method called “root finding”. The goal of this exercise is for you to develop a simple program to find a root using a method we discussed in class: Newton’s method. Your program will be designed to solve a very simple equation. The energy-budget model equation will be more complicated, but you will see that once you have a computer method to solve the simple equation in this exercise, the same method can be expanded upon to solve more complicated equations.

The object is to solve:

$$y = x^2 \quad \text{for } y = 7.$$

In other words, we need to find the roots of the following:

$$x^2 - 7 = 0$$

Essentially, this means that we are trying to calculate the square root of 7. You might notice that there are really two roots – that x can be either positive or negative. For this exercise, just find the positive root and don’t worry about the negative root.

We will be using this same basic method in the next lab project to follow and so you would be doing yourself a big favor to write the program using Python functions, as discussed in lecture. If you create a function containing the above function ($x^2 - 7$) and then also create a function to calculate the derivative, you will be able to just change that first function into one that represents next week’s model.

Newton’s method needs a starting point and so you can use something like 2.0 or 3.0 as a starting estimate (we can guess that the square root of 7 is between 2 and 3). Provide a solution that is accurate to at least ± 0.00001 (6 digits or 5 digits to the right of the decimal). In your results, provide a simple table showing the solution for each step of the iteration process. Also include a listing of your program.