Answer on Question #52495 – Math – Algorithms | Quantitative Methods

The bacteria concentration in a reservoir varies as

c= e^t - (t^3/6) (e^0.3t) - t^2/2 - t

where is the time in seconds. Use the Newton-Raphson method to estimate the time required for the bacteria concentration to reach 1 (correct up to 2 decimal places)

Solution

$$c = e^t - \frac{t^3}{6}e^{0.3t} - \frac{t^2}{2} - t = 1 \rightarrow \; e^t - \frac{t^3}{6}e^{0.3t} - \frac{t^2}{2} - t - 1 = 0;$$

Newton-Raphson method:

$$t_{n+1} = t_n - \frac{f(t_n)}{f'(t_n)}$$

Here $f(t) = e^t - \frac{t^3}{6}e^{0.3t} - \frac{t^2}{2} - t - 1,\; f'(t) = e^t - \frac{t^2(t+10)}{20}e^{0.3t} - t - 1$

n	t_n
0	3
1	2.695
2	2.490
3	2.390
4	2.365
5	2.363

Thus, the bacteria concentration will reach 1 in 2.36 sec.