Answer on Question #51400 – Math – Algorithms | Quantitative Methods

The current in an electric circuit is given by i=t sin t
where t is the time in seconds. Using the bisection method, estimate the time required for the current to reach 1 amp (correct up to 2 decimal places)

Solution

We must solve the equation $t\sin t-1=0$ using the bisection method.

The input for the method is a continuous function *f*, an interval [*a*, *b*], and the function values *f*(*a*) and *f*(*b*). The function values are of opposite sign (there is at least one zero crossing within the interval). Each iteration performs these steps:

1. Calculate *c*, the midpoint of the interval, *c* = 0.5 * (*a* + *b*).
2. Calculate the function value at the midpoint, *f*(*c*).
3. If convergence is satisfactory (that is, *a* - *c* is sufficiently small, or *f*(*c*) is sufficiently small), return *c* and stop iterating.
4. Examine the sign of *f*(*c*) and replace either (*a*, *f*(*a*)) or (*b*, *f*(*b*)) with (*c*, *f*(*c*)) so that there is a zero crossing within the new interval.

Let's start with values of a = 0 and b = 2.

$f\left(t\right)=t\sin t-1$

$f\left(0\right)=-1$

$f\left(2\right)=0.818595$

So, for example, on the first iteration we get $f\left(c_n\right)=-0.158529$ and so must replace the value of the left endpoint of interval *a* with $c_1=1$ hence narrowing the interval.
Iteration process is represented by the following table:

Iteration	a_n	b_n	c_n	$f\left(c_n\right)$
1	0	2	1	-0.158529
2	1	2	1.5	0.496242
3	1	1.5	1.25	0.186231
4	1	1.25	1.125	0.015051
5	1	1.125	1.0625	-0.0718266
6	1.0625	1.125	1.09375	-0.0283617
7	1.09375	1.125	1.10938	-0.00664277
8	1.10938	1.125	1.11719	0.00421152
9	1.10938	1.11719	1.11328	-0.00121128
10	1.11328	1.11719	1.11524	0.0014969

We see that root of the equation $t\sin t-1=0$ is 1.11524 with accuracy up to two decimal places.