

TI-84+ Lab 10 For Mathematics 224

Topics: Euler’s method to approximate differential equations

Euler’s Method. Approximate $\frac{dy}{dx} = y - 2x$, start at $(x, y) = (0, 1)$, $0 \leq x \leq 2$ use subinterval $h = 0.4$.

- *Euler’s Approximation*

- Since

$$\frac{dy}{dx} = y - 2x, \quad \text{then} \quad g(x, y) = y - 2x$$

- and since $x_0 = 0, y_0 = 1$, then

$$g(x_0, y_0) = y_0 - 2x_0 = 1 - 2(0) = 1$$

- and since $h = 0.4$,

$$y_1 = y_0 + g(x_0, y_0)h = 1 + 1(0.4) = 1.4$$

- but, now, since $x_1 = x_0 + h = 0 + 0.4 = 0.4$ and

$$g(x_1, y_1) = y_1 - 2x_1 = 1.4 - 2(0.4) = 0.6$$

- and since $h = 0.4$,

$$y_2 = y_1 + g(x_1, y_1)h = 1.4 + 0.6(0.4) = 1.64$$

- Remainder of (x_i, y_i) values given in table below.

		Euler’s Approximation	Actual Solution	Difference
		$y_0 = 1$		
i	x_i	$y_i = y_{i-1} + (y_{i-1} - 2x_{i-1})(0.4), i \geq 1$	$f(x_i) = 2x_i + 2 - e^{x_i}$	$y_i - f(x_i)$
0	0	1.00	1.00	0.00
1	0.4	1.40	1.31	0.09
2	0.8	1.64	1.37	0.27
3	1.2	1.66	1.08	0.58
4	1.6	1.36	0.25	1.11
5	2.0	0.62	-1.39	2.01

- *TI-84 calculator: Euler’s approximation*

- define $Y_1 = Y - 2X$,

- initialize X and Y with -0.4 and 1, respectively: $-0.4 \rightarrow X, 1 \rightarrow Y$;

- type Euler’s approximation: $X + 0.4 \rightarrow X : Y + Y_1 \times 0.4 \rightarrow Y$ ENTER for 1.4, then ENTER for 1.64, and so on.

- *Actual solution* Define $Y_2 = 2x + 2 - e^X$, then VARS, Y-VARS ENTER Y_2 ENTER $Y_2(0.4)$ ENTER for 1.31, and so on.