

## QUADRATURE v1.1

This program calculates the approximate definite integral for a given function using the following methods: Trapezoidal Rule, Simpson 1/3 Rule, Simpson 3/8 Rule and Gauss-Legendre Quadrature.

### Example:

Use the Newton-Cotes Methods with the indicated values of  $n$  to approximate the following integral:

$$\int_{-0.5}^{0.5} x \times \ln(x + 1) dx, n = 6$$

- Identify the necessary data:

$$f(x) = x \times \ln(x + 1)$$

$$\text{lower limit: } a = -0.5$$

$$\text{upper limit: } b = 0.5$$

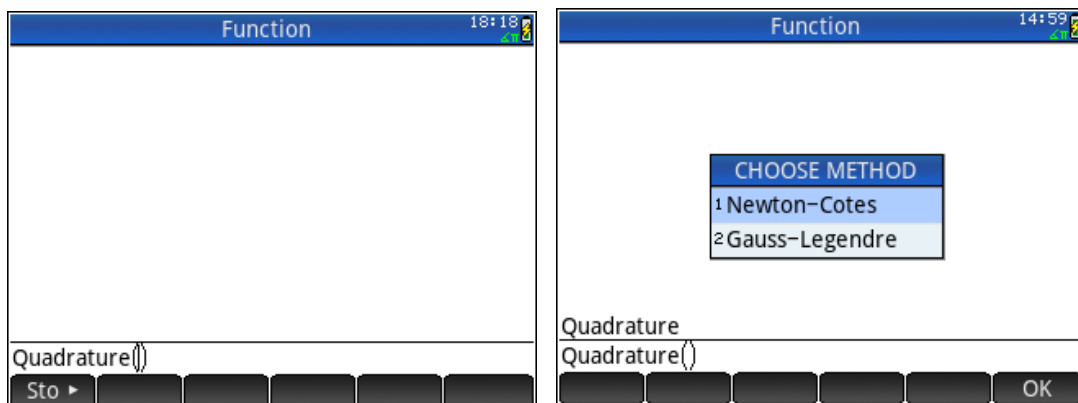
$$\text{segments size: } h = \frac{0.5 - (-0.5)}{6} = 0.1666667$$

$$\text{number of segments: } n = 6$$

$$\text{number of base points: } N = 6 + 1 = 7$$

### How to use the program:

- Run the program in the HOME window and choose “Newton-Cotes”.



- Input the necessary data: function, lower limit, upper limit, plus an extra data which can be: segments size, number of segments or number of base points (notice that there's a box in which you can choose what data to enter).

**INPUT DATA** 18:19

f(X)=  $X \cdot \ln(X+1)$

a= -0.5      b= 0.5

√ Segments size = 0

Number of segments =

Number of base points =

Choose the type of data you will input

**INPUT DATA** 18:20

f(X)=  $X \cdot \ln(X+1)$

a= -0.5      b= 0.5

Number of segments = 6

Enter the data

Edit Cancel OK

### Results:

- Function values.

**FUNCTION VALUES** 18:20

	$X_i$	$f(X_i)$	3
1	-0.5	0.3465736	
2	-0.333333	0.1351550	
3	-0.166667	3.0387E-2	
4	0	0	
5	0.166667	2.5692E-2	
6	0.333333	9.5894E-2	
7	0.5	0.2027326	
8			

Edit More Go To Go → Cancel OK

- Approximate integral.

**Terminal** 18:20

```

***** TRAPEZOIDAL RULE *****
➤ Approx. Integral = 9.36301397405E-2
***** SIMPSON'S 1/3 RULE *****
➤ Approx. Integral = 8.80922109576E-2
***** SIMPSON'S 3/8 RULE *****
➤ Approx. Integral = 8.81680901981E-2

```

## NEW (v1.1): Gauss-Legendre Quadrature

### Example:

Repeat exercise 1 using Gaussian quadrature with  $n=3$ .

$$\int_{-0.5}^{0.5} x \times \ln(x + 1) dx$$

- Identify the necessary data:

$$f(x) = x \times \ln(x + 1)$$

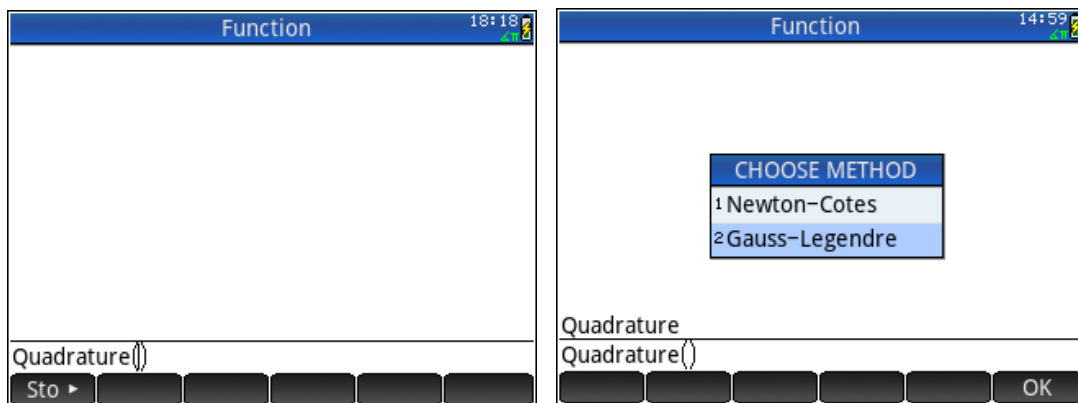
lower limit:  $a = -0.5$

upper limit:  $b = 0.5$

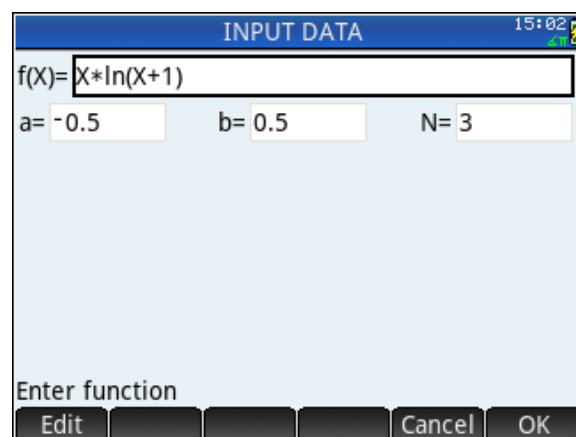
number of base points:  $n = 3$

### How to use the program:

- Run the program in the HOME window and choose “Gauss-Legendre”.



- Input the necessary data: function, lower limit, upper limit and number of base points.



## Results:

- Change of variables.

```
Terminal 15:02
✓ X ∈ [a,b]
⇒ X ∈ [-0.5, 0.5]
✓ Z ∈ [-1, 1]

✓ X = (b+a)/2 + (b-a)/2 * Z
✓ F(Z) = f[(b+a)/2 + (b-a)/2 * Z] * (b-a)/2
⇒ (b+a)/2 = 0
⇒ (b-a)/2 = 0.5
⇒ X = 0 + 0.5 * Z
⇒ F(Z) = f[0 + 0.5 * Z] * 0.5
```

- Results: Weighting factors, function arguments and function values.

RESULTS 15:03				
	Wi	Zi	F(Zi)	Wi * F(Zi)
1	0.8888889	0	0	0
2	0.5555556	0.7745967	6.3393E-2	3.5218E-2
3	0.5555556	-0.774597	9.4864E-2	5.2702E-2
4				

Edit More Go To Go → Cancel OK

- Approximate Integral.

```
Terminal 15:03
✓ X ∈ [a,b]
⇒ X ∈ [-0.5, 0.5]
✓ Z ∈ [-1, 1]

✓ X = (b+a)/2 + (b-a)/2 * Z
✓ F(Z) = f[(b+a)/2 + (b-a)/2 * Z] * (b-a)/2
⇒ (b+a)/2 = 0
⇒ (b-a)/2 = 0.5
⇒ X = 0 + 0.5 * Z
⇒ F(Z) = f[0 + 0.5 * Z] * 0.5

➤ Approx. Integral = Σ(Wi * F(Zi))
➤ Approx. Integral = 0.087920525316
```