

# Visual Basic – Exercises

## Numerical integration

The final task on writing **Function** procedures will be to create a function that carries out numerical integration. You may be familiar with the trapezium rule method which approximates the area under the curve by a succession of trapezia. A better approximation is afforded by Simpson's rule. The range of integration  $(a, b)$  is divided into an even number,  $n$ , of intervals each of width  $h = (b - a) / n$ . If the ordinates are  $y_0, y_1, y_2, y_3, \dots, y_n$  then the integral

$$\int_a^b y(x)dx \approx \frac{h}{3} [(y_0 + y_n) + 4(y_1 + y_3 + \dots + y_{n-1}) + 2(y_2 + y_4 + \dots + y_{n-2})]$$

- Write a **function** procedure called `SimpsonInt` that uses Simpson's rule to evaluate an integral.
- Your procedure should take three arguments: the lower and upper limits of integration and the number of intervals.
- Since the rule is only valid if the number of intervals is even and at least two, your procedure should first check for valid data and give an error message if necessary.
- The procedure should evaluate the integrand  $y(x)$  by using a user-defined function `Func(x)`. To integrate a different function you should only need to change `Func`, not `SimpsonInt`.
- When you change `Func` you will probably need to press `Ctrl+Alt+F9` to recalculate all spreadsheet cells using the new function.

Test your procedure using known functions with known integrals, e.g.  $y(x) = \exp(x)$  or  $y(x) = \exp(-x)$  over a range such as  $(0, 4)$  which you can check analytically using Excel's functions. Then try some other functions, such as

1. the  $\text{sinc}(x)$  function which you wrote earlier, with limits  $(0, 20)$ ,
2.  $\exp(-x^2)$  which you cannot do analytically. (You can check it using the `NORMDIST` function within Excel).

Save your spreadsheet and its associated macros as "*username-Simpson*".