

## Practical Answers 10 – Numerical Integration

1. Use Matlab's integral function to evaluate the following integral.

$$\int_{-2}^4 (1 - x - 4x^3 + 2x^5) dx$$

1104

2. Use Matlab's trapz function to determine the distance travelled as recorded in the following data table of velocity and time.

<i>t</i>	1	2	3.25	4.5	6	7	8	8.5	9	10
<i>v</i>	5	6	5.5	7	8.5	8	6	7	7	5

60.1250

3. Use any Matlab functions to fit a cubic polynomial to the data in Question 2 then calculate it's integral over the given time domain. How does it compare with the trapezium rule estimate in Matlab?

60.0224

4. The total mass of a variable density rod is given by,

$$m = \int_0^L \rho(x) A_c(x) dx$$

where  $m$  is mass,  $\rho$  is density,  $A_c$  is cross-sectional area,  $x$  is the distance along the rod, and  $L$  is the total length of the rod. The following data was taken from a 20 m rod. Determine the mass in grams of the rod.

<i>x, m</i>	0	4	6	8	12	16	20
$\rho, \text{g/cm}^3$	4.00	3.95	3.89	3.80	3.60	3.41	3.30
$A_c, \text{cm}^2$	100	103	106	110	120	133	150

8631.4

5. Write a function file that implements the composite trapezium rule. The inputs should be the function to be integrated, a starting point, an end point, and a number of segments.

N/A

6. Write a function file that implements the composite Simpson's  $1/3$  rule. The inputs should be the function to be integrated, a starting point, an end point, and a number of segments. Your function should check that the user provided an even number of segments (consider what default behaviour you will do if there are an odd number of segments).

N/A

7. Write a function file that implements the trapezium rule **for unequal spacing**. The inputs should be 2 vectors of data. Be sure to check that the number of data points in each vector is the same.

N/A

8. Adapt your trapezium rule function file for unequal spacing to **sort the data** in case the data for the independent variable is not provided in a monotonically ascending vector.

N/A

## Challenge Problem

Improve your functions from questions 5 and 6 to also return the approximate error.