

Numerical Methods in Engineering: Assignment week 6

1. The diameter d of a ball from American football is measured at different points along the z , see Fig.1. The surface area and the volume needs to be estimated. The surface area S and the volume V can be expressed as:

$$S = 2\pi \int_0^L r dz; \quad V = \pi \int_0^L r^2 dz$$

Use the data of Table 1 to define the surface area and the volume of the ball by using composite Simpson's 1/3 method. Use hand calculations. (20%)

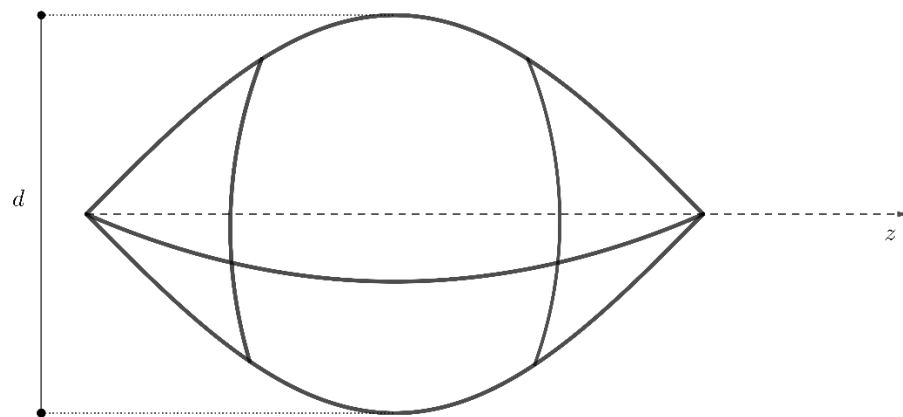


Figure 1. Ball of American football

z(in.)	0	1	2	3	4	5	6	7	8	9	10	11	12
d(in.)	0	2.6	3.2	4.8	5.6	6	6.2	6	5.6	4.8	3.3	2.6	0

2. A unit circle (radius equal to 1) is expressed by the equation $x^2 + y^2 = 1$ and therefore its area is equal to π , see Fig.2. The area of the half circle can be defined as follows:

$$x^2 + y^2 = 1 \Leftrightarrow y = \sqrt{1 - x^2}$$

$$A_{hc} = \int_{-1}^1 \sqrt{1 - x^2} dx = \frac{\pi}{2}$$

Use the following methods to evaluate the integral:

- (a) Composite Simpson's 1/3 method (use 8 subintervals)
- (b) Composite Simpson's 3/8 method (use 9 subintervals)
- (c) Second order (n=2) Gauss quadrature

Write MatLab scripts to derive the results, compare and discuss them. Return MatLab scripts and report with formulas used, comparison and discussions. The only MatLab build-in functions you are allowed to use are: sqrt, sum. (20%)

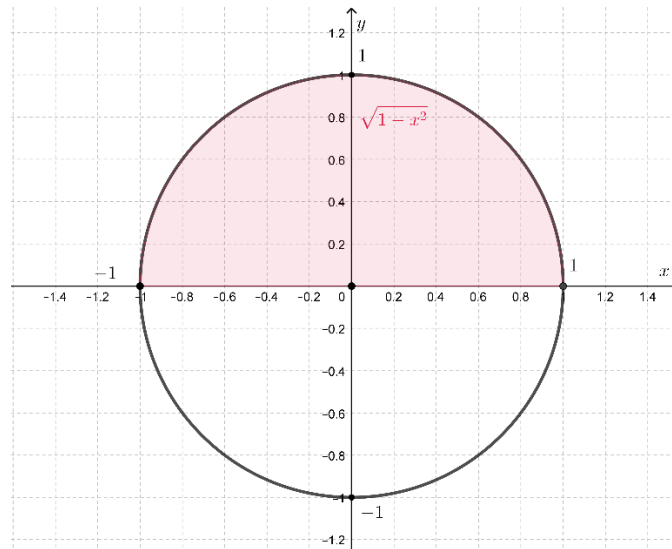


Figure 2: Unit circle

3. Develop a user-defined MatLab function $I = \text{Comptrapez}(\text{FunName}, a, b)$ of integrating a function by using the composite trapezoidal method. FunName is a handle function that calculates the value of the function to be integrated, a and b are the limits of integration and I is the value of the integral. The function should calculate the value of the integral in iterations. In the first iteration the interval $[a, b]$ is divided in two subintervals and in every iterations that follows the number of subintervals should be doubled. Stop the iterations when the difference in the value between two successive iterations is smaller than 1%. Check your function with questions 1 and 2. The only MatLab build-in function you are allowed to use is: sum. Return MatLab file and a report with the results from the questions 1 and 2 using the function (you can use *polyfit* of MatLab, function 6th degree polynomial for q1) (30%)
4. Repeat exactly the same process described in question 3 to write a user-defined MatLab function $I = \text{Simp38}(\text{FunName}, a, b)$ using the composite Simpson's 3/8 method. Check your function with questions 1 and 2. The only MatLab build-in function you are allowed to use is: sum. Return MatLab file and a report with the results from the questions 1 and 2 using the function (you can use *polyfit* of MatLab, function 6th degree polynomial for q1). (30%)

Grading criteria:

Correctness

Justification

Efficiency

Presentation