Assignment 5

Numerical Integration and Differentiation

Actual value of integral = 0.654448934

Method	N=10	N=100
Trapezoidal Rule	0.654122571724138	0.654445668395524
Corrected Trapezoidal Rule	0.654407083576268	0.654448890205024
Simpson Rule	0.654448139372112	0.654448933890907

	N=1	N=2	N=4
Gauss Quadrature	0.668640128011117	0.654872532500504	0.654448969529334

Derivative Calculated

X=0.1 and N = 10

First derivative = 1.183690154

	Forward	Central	Backward
First Order	1.260156909596240	1.177414092834029	1.094671276071818
Second Order	1.197983760814176	1.183663086502650	1.194338386865609

X=0.5 and N = 10

First derivative = 1.479340777

	Forward	Central	Backward
First Order	1.453823636963537	1.469757243899494	1.485690850835451
Second Order	1.498818115737550	1.479282308227509	1.497846758029533

X=0.1 and N = 100

First derivative = 1.183690154

	Forward	Central	Backward
First Order	1.191931850275214	1.183627326645756	1.175322803016297
Second Order	1.183817637087059	1.183690151693899	1.183813966493311

X=0.5 and N = 100

First derivative = 1.479340777

	Forward	Central	Backward
First Order	1.477659526239195	1.479244796882884	1.480830067526573
Second Order	1.479533212234774	1.479340771525840	1.479532229388730

Analytical values of Derivatives

X=0.5

First Derivative = 1.183690154

X=0.5

First Derivative = 1.479340777

Results and Analysis

The actual value of the integral between 0 and 1 is 0.654448934

- Simpson method for N=100 and corrected trapezoidal rule for N=100 gave the closest approximation to this value.
- In all three cases N=100 gave a better answer than N=10. This is quite expected since more number of data points correspond to more information and better prediction.
- Corrected Trapezoidal rule clearly showed a much better approximation compared to the basic one.
- At $\Delta x=0.1$ forward and backward difference gave very poor estimates for the derivatives.
- At $\Delta x=0.1$ central difference gave a rough estimate.
- For $\Delta x=.01$ again forward and backward difference gave a rough estimate.
- For $\Delta x=.01$ Central difference method gave a very good estimate of the actual derivative
- This trend was the same for both x=.1 and .5.

Interpretation

- Always more number of data points gave a better estimate
- Simpson rule and Corrected trapezoidal rule are good for numerical integration to a good extent.
- Gauss method becomes considerably better with increasing number of points.
- For calculating the derivative central difference method always gives the best estimate.