Sample Questions on Numerical Integration

1. Trapezoidal Rule

Conceptual Questions

Q1. The trapezoidal rule approximates the area under a curve by:

(a) Fitting a straight line between points.

(b) Fitting a quadratic polynomial between points.

(c) Fitting a cubic polynomial between points.

(d) Using random sampling.

Q2. For the trapezoidal rule, the error is proportional to:

(a) h^2

(b) h^3

(c) h^{-1}

(d) h

Numerical Questions

Q3. Use the trapezoidal rule with $n = 2$ to approximate $\int_0^1 x^2\,dx$:

(a) 0.25

(b) 0.333

(c) 0.5

(d) 0.375

Q4. Compute $\int_1^3 x^2\,dx$ using the trapezoidal rule with $n = 4$:

(a) 8.6667

(b) 9.0

(c) 8.5

(d) 9.3333

2. Simpson's 1/3 Rule

Conceptual Questions

Q5. Simpson's 1/3 rule requires the number of intervals n to be:

(a) Odd.

(b) Even.

(c) Prime.

(d) Any value.

Q6. Simpson's 1/3 rule is exact for:

(a) Linear functions.

(b) Quadratic functions.

(c) Cubic functions.

(d) Exponential functions.

Numerical Questions

Q7. Use Simpson's 1/3 rule to approximate $\int_0^1 x^2\,dx$ with $n = 2$:

(a) 0.3333

(b) 0.3750

(c) 0.3417

(d) 0.3167

Q8. Approximate $\int_0^2 e^x\,dx$ using Simpson's 1/3 rule with $n = 4$:

(a) 6.389

(b) 6.420

(c) 6.319

(d) 6.500

3. Simpson's 3/8 Rule

Conceptual Questions

Q9. Simpson's 3/8 rule divides the interval into subintervals that are multiples of:

(a) 3.

(b) 4.

(c) 2.

(d) 5.

Q10. The degree of the polynomial that Simpson's 3/8 rule integrates exactly is:

(a) Linear.

(b) Quadratic.

(c) Cubic.

(d) Quartic.

Numerical Questions

Q11. Use Simpson's 3/8 rule to approximate $\int_0^3 x^3\,dx$ with $n = 3$:

(a) 20.25

(b) 21.75

(c) 20.5

(d) 21.33

Q12. Approximate $\int_0^1 \sin(x)\,dx$ using Simpson's 3/8 rule with $n = 3$:

(a) 0.4597

(b) 0.4600

(c) 0.4555

(d) 0.4589

4. Monte Carlo Integration

Conceptual Questions

Q13. Monte Carlo integration is best suited for:

(a) Low-dimensional integrals.

(b) High-dimensional integrals.

(c) Functions with known antiderivatives.

(d) Periodic functions.

Q14. The error in Monte Carlo integration decreases as:

(a) $O(1/n^2)$.

(b) $O(1/\sqrt{n})$.

(c) $O(1/n^3)$.

(d) $O(n)$.