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Grade	**12.00** out of 12.00 (**100**%)

Question **1**
Correct
Mark 1.00 out of 1.00

When using the formulas shown during this course to estimate values for derivatives, we want the error to be as small ✔ as possible. For this reason, for accuracy, a formula with an error of $O(h^2)$ is better ✔ than a formula with an error of $O(h)$.

Your answer is correct.

The correct answer is:
When using the formulas shown during this course to estimate values for derivatives, we want the error to be as [small] as possible. For this reason, for accuracy, a formula with an error of $O(h^2)$ is [better] than a formula with an error of $O(h)$.

Question **2**
Correct
Mark 1.00 out of 1.00

What is the formula for the centered estimate of the first derivative of f that has an $O(h^4)$ error term?

Select one:

a. ✔
$$f'(x_i) = \frac{-f(x_{i+2}) + 8f(x_{i+1}) - 8f(x_{i-1}) + f(x_{i-2})}{12h}$$

b.
$$f'(x_i) = \frac{-f(x_{i+2}) + 8f(x_{i+1}) - 8f(x_{i-1}) + f(x_{i-2})}{h^2}$$

c.
$$f'(x_i) = \frac{-f(x_{i+2}) + 6f(x_{i+1}) - 6f(x_{i-1}) + f(x_{i-2})}{12h}$$

d.
$$f'(x_i) = \frac{f(x_{i+1}) - f(x_{i-1})}{2h}$$

The correct answer is: $$ f'(x_i) = \frac{-f(x_{i+2}) + 8f(x_{i+1}) -8f(x_{i-1}) +f(x_{i-2})}{12h} $$

Question **3**

Correct

Mark 1.00 out of 1.00

Suppose we have a function \(f\) and that \(f(0) = 3.7\) \(f(0.5) = 3.8\). Use the lower accuracy centered difference formula to estimate the first derivative of \(f\) at \(x=0.25\) Give your answer to 1 decimal place.

Answer: 0.2 ✔

The correct answer is: 0.2

Question **4**

Correct

Mark 1.00 out of 1.00

What is the formula for calculating the terms \(R(n,k)\) for \(k >0\) using the Romberg method?

Select one:

- a. $$ R(n,k) = \frac{kR(n,k-1) - R(n-1,k-1)}{k-1} $$
- b. $$ R(n,k) = \frac{4^kR(n,k-1) - R(n-1,k-1)}{4^k-1} $$ ✔
- c. $$ R(n,k) = \frac{R(n,k-1) + R(n-1,k-1)}{2} $$
- d. $$ R(n,k) = \frac{4R(n,k-1) - R(n-1,k-1)}{3} $$

The correct answer is: $$ R(n,k) = \frac{4^kR(n,k-1) - R(n-1,k-1)}{4^k-1} $$

Question **5**

Correct

Mark 1.00 out of 1.00

Suppose we have a function \(f\) and that \(f(1) = 5.7\) \(f(1.25) = 8\) \(f(1.5) = 2.5\) \(f(1.75) = 5.5\) \(f(2) = 7.1\).

Use the higher accuracy centered difference formula to estimate the second derivative of \(f\) at \(x=1.5\) Give your answer to 1 decimal place.

Answer: 170.9 ✔

The correct answer is: 170.9

Question **6**

Correct

Mark 1.00 out of 1.00

What is the high accuracy formula for the backward estimate of the second derivative?

Select one:

- a. $$f''(x_i) =\frac{-f(x_{i+2}) + 4f(x_{i+1})-3f(x_i)}{2h} $$
- b. $$f''(x_i) = \frac{f(x_i) - f(x_{i-1}) + f(x_{i-2}) - f(x_{i-3})}{h^2} $$
- c. $$f''(x_i) = \frac{2f(x_i) - 5f(x_{i-1}) + 4f(x_{i-2}) - f(x_{i-3})}{h^2} $$ ✔
- d. $$f''(x_i) = \frac{2f(x_i) - 5f(x_{i-1}) + 4f(x_{i-2}) - f(x_{i-3})}{2h} $$

The correct answer is: $$f''(x_i) = \frac{2f(x_i) - 5f(x_{i-1}) + 4f(x_{i-2}) - f(x_{i-3})}{h^2} $$

Question **7**

Correct

Mark 1.00 out of 1.00

Under what circumstances can we use Richardson extrapolation to get better estimates?

Select one:

- a. When we have a formula for estimating a value that has an error term that can be expressed using a power series ✔
- b. When the function can be modelled by a freely converging continuous Romberg power series
- c. When the Taylor series is differentiable
- d. When our values are Romberg integrable

The correct answer is: When we have a formula for estimating a value that has an error term that can be expressed using a power series

Question **8**

Correct

Mark 1.00 out of 1.00

What is the formula for the order \(h\) forward estimate of the derivative of \(f\) at \(x_i\) with step size \(h\).

Select one:

- a. $$ f'(x_i) = \frac{f(x_{i})-f(x_{i-1})}{h} $$
- b. $$ f'(x_i) = \frac{f(x_{i+1})-f(x_i)}{h} $$ ✔
- c. $$ f'(x_i) = \frac{f(x_{i+1})-f(x_i)}{h^2} $$
- d. $$ f'(x_i) = \frac{f(x_{i+2})-2f(x_{i+1}+f(x_i))}{h^2} $$

The correct answer is: $$ f'(x_i) = \frac{f(x_{i+1})-f(x_i)}{h} $$

Question **9**

Correct

Mark 1.00 out of 1.00

Suppose we use the composite trapezoid rule to estimate the value of an integral. Suppose we do two estimates, one using \(h_0 = 0.5\) and another using \(h_1 = 0.25\).

Suppose the first estimate produces \(I_0 = 38.9\) and the second estimate produces \(I_1 = 52.3\)

Combine these estimates into a better one using the Romberg method. Give your answer to 2 decimal places.

Answer: 56.76

The correct answer is: 56.77

Question **10**

Correct

Mark 1.00 out of 1.00

Given a function \(f(x)\) what is the name for the series \[f(a) + f'(a)(x-a) + \frac{f''(a)}{2}(x-a)^2 + \frac{f^{(3)}(a)}{3!}(x-a)^3 + ... ?\]

Select one:

- a. The Newton series
- b. The Taylor series
- c. The Simpson series
- d. The Euler series

The correct answer is: The Taylor series

Question **11**

Correct

Mark 1.00 out of 1.00

Suppose we have a function \(f\) and that \(f(0) = 2.7\) \(f(0.5) = 10.2\) \(f(1) = 14\) Use the lower accuracy forward difference formula to estimate the second derivative of \(f\) at \(x=0\) Give your answer to 1 decimal place.

Answer: -14.79

The correct answer is: -14.8

Question **12**

Correct

Mark 1.00 out of 1.00

The Romberg estimates $R(n,1)$ for $n\geq 0$ are equivalent to which integral estimate with 2^n segments?

Select one:

- a. Richardson extrapolation
- b. Composite Simpson's 1/3 rule ✔
- c. Simpson's 3/8 rule
- d. The composite trapezoid rule

The correct answer is: Composite Simpson's 1/3 rule

◄ Homework 13

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Quiz 1 (Sec 1) ►