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**MTH603 Assignment 2**

**Solution**

**Question 01:**

Find *f* '(1.40) and *f* ''(1.40) by using Newton's Backward difference formula for derivatives from the following table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *x* | 1.24 | 1.28 | 1.32 | 1.36 | 1.40 |
| *f(x)* | 3.2542 | 4.1562 | 4.8531 | 5.4623 | 6.1811 |

**Solution:**

**Step 1: Calculate the backward difference for the first derivative (f'(1.40)):**

Δx = 1.40 - 1.36 = 0.04

Δy = f(1.40) - f(1.36) = 6.1811 - 5.4623 = 0.7188

**Step 2: Calculate f'(1.40):**

Using the formula for the first derivative:

f'(1.40) ≈ Δy / Δx = 0.7188 / 0.04 = 17.97

So, f'(1.40) ≈ 17.97

**Step 3: Calculate the backward difference for the second derivative (f''(1.40)):**

Now, we need to find the second difference:

Δx = 1.36 - 1.32 = 0.04

Δy1 = f(1.36) - f(1.32) = 5.4623 - 4.8531 = 0.6092

**Step 4: Calculate f''(1.40):**

Using the formula for the second derivative:

f''(1.40) ≈ Δ^2y / Δx2

Δ2y = Δy1 - Δy = 0.6092 - 0.7188 = -0.1096

Now, calculate f''(1.40):

f''(1.40) ≈ Δ2y / Δx2 = (-0.1096) / 0.04 = -2.74

So, f''(1.40) ≈ -2.74

Therefore, using Newton's Backward Difference Formula, we have found that:

f'(1.40) ≈ 17.97 f''(1.40) ≈ -2.74



**Solution:**

**Interval Width (h):**

*h*= ​ = ​ =​ = 1.5

**Interval Points (x):**

The points are *x*0​,*x*1​,*x*2​,…,*x*8​, where *xi*​ = *a* + *i*⋅*h*.

*x*0 =0

*x*1​=1.5

*x*2​=3

*x*3​=4.5

*x*4​=6

*x*5​=7.5

*x*6​=9

*x*7​=10.5

*x*8​=12

**Function Values at Each Point (f(x)):** We calculate

*f*(*xi*​)=*e*−3*xi*​ + 0.5 for each *xi*​.

**Simpson's Rule Formula:**

Let's calculate the function values at each point and then apply Simpson's Rule to get the approximation.

Here are the detailed calculations for each step:

* **Function Values at Each Interval Point *f*(*xi*​):**

*f*(*x*0​) = *f*(0) = 1.5

*f*(*x*1​) = *f*(1.5) ≈ 0.5111

*f*(*x*2​) = *f*(3) ≈ 0.5001

*f*(*x*3​) = *f*(4.5) ≈ 0.5000

*f*(*x*4​) = *f*(6) ≈ 0.5000

*f*(*x*5​) = *f*(7.5) ≈ 0.5000

*f*(*x*6​) = *f*(9) ≈ 0.5000

*f*(*x*7​) = *f*(10.5) ≈ 0.5000

*f*(*x*8​) = *f*(12) = 0.5000

* **Applying Simpson's Rule:**

≈6.522