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Subject : CBNST

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1) $u = \frac{4x^2y^3}{z^4}$

$x = y = z = 1$

$$\delta u = \frac{\delta u}{\delta x}\delta x + \frac{\delta u}{\delta y}\delta y + \frac{\delta u}{\delta z}\delta z$$

$$\frac{4\,2(x)y^3}{z^4}\delta x + \frac{4x^2\,3(y^2)}{z^4} + (-4x^2y^3z^{-5})\delta z$$

$$\frac{8xy^3}{z^4}\delta x + \frac{12x^2y^2}{z^4}\delta y - \frac{16x^2y^3}{z^5}\delta z$$

Since, δx, δy, δz may be (+ve) or (-ve). so.

$$(\delta u)_{max} = \left|\frac{8xy^3}{z^4}\cdot\delta x\right| + \left|\frac{12x^2y^2}{z^4}\delta y\right| + \left|\frac{16x^2y^3}{z^5}\delta z\right|$$

Putting values of δx, δy, δz i.e., 0.01 and x, y, z i.e., 1

=

$8(0.01) + 12(0.01) + 16(0.01)$

$0.08 + 0.12 + 0.16$

$= 0.36$

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2)

u	x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$
-3	1	5				
			3			
-2	2	8		0		
			3		0	
-1	3	11		0		0
			3		0	
0	$\boxed{4}$	14		0		
			3			
1	5	17				

y_0

x_0

$f(3.5) = ?$

$x_1 = 3.5 \quad x_0 = 4 \quad h = 1, \quad y_0 = 14$

$u = \frac{x - x_0}{h} = -0.5 \qquad -1 < -0.5 < 0$

$\boxed{u = -0.5}$

Using Backword's interpolation formula

$$y_x = y_0 + u\Delta y_{-1} + \frac{(u+1)u}{2!}\Delta^2 y_{-1} + \frac{(u+1)(u-1)u}{3!}\Delta^3 y_{-2}$$

$$+ \frac{(u+2)(u+1)u(u-1)}{4!}\Delta^4 y_{-2}$$

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$$= 14 + 3(-0.5) + \frac{(-0.5+1)(-0.5)}{2!}\cdot 0 + 0 + 0$$

$$14 - 1.5 = 12.5$$

= Ans

5> b> Since regression lines always intersect at pt. $(\bar{x}, \bar{y})$ representing mean values of $\bar{x}$ and $\bar{y}$.

$8x - 10y = -66$ — (1)

$40x - 18y = 214$ — (2)

using eq (1) and (2) we have,

$32y = 544$

$\bar{y} = 17$

Then. $\bar{x} = (10\bar{y} - 66)/8 = \frac{(10.17 - 66)}{8} = 13$

to find coefficient of corelation b/w x and y

$8x - 10y = -66$

$10y = 66 + 8x$

$y = \frac{66 + 8x}{10}$

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i.e.,

$$b_{yx} = \frac{8}{10} = 0.8$$

$$40x - 18y = 214$$

$$40x = 214 + 18y$$

$$x = \frac{214}{40} + \frac{18}{40} y$$

i.e., $b_{xy} = \frac{18}{40} = 0.45$

So, coefficient of correlation b/w x and y is given by:

$$r = \sqrt{b_{xy} \times b_{yx}} = \sqrt{0.45 \times 0.80} = 0.60$$

For standard deviatⁿ of y

$$\sigma_y = \frac{b_{yx}\, \sigma_x}{r} = \frac{0.8 \times \sqrt{9}}{0.6} = 4$$

3) a) Difference table:

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$
1.2	1.5095				
		0.1889			
			0.017		
1.3	1.6984				
				0.0021	
		0.2059			
					0.0041
			0.0191		
1.4	1.9043				
		0.225		0.0062	
			0.0253		
1.5	2.1293				
		0.2503			
1.6	2.3796				

$x = 1.4 \quad h = 0.1 \quad x_0 = 1.4$

$$y'_{1.4} = \frac{1}{h}\left(\Delta y_0 - \frac{1}{2}\Delta^2 y_0 + \frac{1}{3}\Delta^3 y_0 - \frac{1}{4}\Delta^4 y_0\right)$$

$$y'_{1.4} = \frac{1}{0.1}\left(0.025 - \frac{1}{2} \times 0.0253 + \frac{1}{3} \times 0 - \frac{1}{4} \times 0\right)$$

$$y'_{1.4} = 2.1235$$

$$y''_{1.4} = \frac{1}{0.01}\left(0.0253 - 0 + \frac{11}{12} \times 0\right)$$

$$y''_{1.4} = 2.53$$

i) $f'(a) = f(a, a+h) = \frac{f(a+h) - f(a)}{h}$

$f'(1.4) = f(1.4, 1.5) = \frac{f(1.4+0.1) - f(1.4)}{0.1}$

$= \frac{2.1293 - 1.9043}{0.1} = 2.250$

$E = |2.250 - 2.1235| = 0.1265$

$E = -\frac{1}{2} h f''(1.4) = -\frac{1}{2} \times 0.1 \times 2.53$

$= -0.1265$

equal error

ii) $f'(a) = f(a-h, a+h)$

$= \frac{2.1293 - 1.6984}{0.2}$

$f'(1.4) = 2.154500$

$E = |2.1545 - 2.1235| = 0.0310$

$E = -\frac{1}{2} h f''(1.4) = 0.0310$

4) $\frac{dy}{dx} = \frac{1}{x^2} - \frac{y}{x} - y^2$

$f(x,y) = \frac{1}{x^2} - \frac{y}{x} - y^2$

$x_0 = 1 \quad y_0 = -1$
$h = 0.5$
$x_1 = 1.5. \quad y_1 = ?$

We know that,

$K_1 = h f(x_n, y_n)$

Put $n = 0$

$K_1 = h f(x_0, y_0) = 0.5 \left(\frac{1}{x_0^2} - \frac{y_0}{x_0} - y_0\right)^2$

$= 0.5 \left(\frac{1}{1^2} - \frac{(-1)}{1} - (-1)^2\right)$

$= 0.5 (1+1-1) = 0.5$

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$$K_2 = hf\left[x_0 + \frac{h}{2}; y_0 + \frac{k_1}{2}\right]$$

$$= 0.5\left[\frac{1}{(x_0+h/2)^2} - \frac{y_0 + 0.5/2}{x_0 + h/2} - (y_0 + k_1/2)^2\right]$$

$$= 0.5\left[\frac{1}{(1+0.25)^2} - \frac{(-0.75)}{1.25} - 0.5625\right]$$

$$= 0.5\left[0.64 + 0.6 - 0.5625\right]$$

Since $y_{n+1} = y_n + k$. by runge kutta method.

$y = y_0 + k$
$= -1 + 0.334$
$y_1 = 0.666$

$y(1.5) = -0.666$

$K_2 = 0.33875$

$$K_3 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right)$$

$$= 0.5\left[\frac{1}{(x_0+h/2)^2} - \frac{y_0 + k_2/2}{x_0 + h/2} - (y_0 + k_2/2)^2\right]$$

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$$K_3 = 0.5\left[\frac{1}{(1+0.25)^2} - \frac{(-0.831)}{1.25} - 0.690\right]$$

$$K_3 = 0.5\left[0.64 + 0.665 - 0.690\right]$$

$$K_3 = 0.3075$$

$$K_4 = hf(x_0+h,\ y_0+k_3)$$

$$= 0.5\left[\frac{1}{(x_0+h)^2} - \frac{y_0+k_3}{x_0+h} - (y_0+k_3)^2\right]$$

$$K_4 = 0.5\left[0.444 - (-0.462) - 0.480\right]$$

$$K_4 = 0.213$$

$$K = \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$$

$$k = \frac{1}{6}(0.5 + 2\times0.339 + 2\times0.308 + 0.213)$$

$$\boxed{K = 0.334}$$

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