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Q. Expand y^x up to second term at (1,1).

→ given expression → y^x

taking log of given expression ⟹ $\log y^x$

According to property we can write $\log y^x$ as ⟹ $x \log y$ ($\because \log a^b = b \log a$)

so $f(x,y) = x \log y$

we know that,

In taylor seriers expansion for two variables is

$$f(x,y) = f(a,b) + \frac{1}{1!}\left[(x-a) f_x(a,b) + (y-b) f_y(a,b)\right] + \frac{1}{2!}\left[(x-a)^2 f_{xx}(a,b) + 2(x-a)(y-b) f_{xy}(a,b) + (y-b)^2 f_{yy}(a,b)\right] + \dots \text{①}$$

values of $\underline{\underline{x=1}}$ and $\underline{\underline{y=1}}$

Now,

$f(x,y) \Rightarrow x \log y \Rightarrow 0$

$f(x,y) \Rightarrow \log y \Rightarrow 0$

$f_y(x,y) \Rightarrow \frac{x}{y} \Rightarrow 1$

$f_{xx}(x,y) \Rightarrow 0 \Rightarrow 0$

$f(x,y)(x,y) \Rightarrow \frac{1}{y} \Rightarrow 1$

$f_{yy}(x,y) \Rightarrow \frac{-x}{y^2} \Rightarrow -1$

$$f(x,y) = f(1,1) + \frac{1}{1!}\left[(x-1)\, f_x(1,1) + (y-1)\, f_y(1,1)\right]$$

$$+ \frac{1}{2!}\left[(x-1)^2 f_{xx}(1,1) + 1(x-1)(y-1)\, f_{xy}(1,1)\right.$$

$$\left. + (y-1)^2 f_{yy}(1,1)\right] + \ldots\ldots \infty$$

$$f(x,y) = 0 + 1\left[(x-1)0 + (y-1)1\right] + \frac{1}{2}\left[(x-1)^2 0 + 2(x-1)\right.$$

$$\left.(y-1) + (y-1)^2(-1)\right] + \ldots \infty$$

$$f(x,y) = 0 + 0 + (y-1) + (x-1)(y-1) - (y-1)^2 + \ldots \infty$$

$$f(x,y) = (y-1) + (x-1)(y-1) - (y-1)^2 + \ldots\ldots \infty$$

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