

* In this chapter, we study formulas to approximate the derivatives $f'(x_0)$, $f''(x_0)$, $f'''(x_0)$, ...

* For example • We know $f'(x_0) = \lim_{h \rightarrow 0} \frac{f(x_0+h) - f(x_0)}{h}$

- Here h is a step size
- This limit gives exact value for $f'(x_0)$
- We need to replace $\lim_{h \rightarrow 0} \frac{f(x_0+h) - f(x_0)}{h}$ by a Difference Formula (D.F) to approximate $f'(x_0)$.

* We study three types of Difference Formulas:

① Central Difference formula (C.D.F)

② Backward Difference Formula (B.D.F)

③ Forward Difference Formula (F.D.F)

* Notation • $f_k = f(x_0 + kh)$, $k = 0, \pm 1, \pm 2, \pm 3, \dots$

• That is,

$$\begin{aligned} f_0 &= f(x_0) \\ f_1 &= f(x_0 + h) \\ f_{-1} &= f(x_0 - h) \\ f_2 &= f(x_0 + 2h) \\ f_{-2} &= f(x_0 - 2h) \\ &\vdots \end{aligned}$$