$$e^{x+h} = e^x + e^x h + O(h^2), \qquad \log(x+h) = \log x + x^{-1}h + o(h).$$

Thus coefficient extraction gives exactly the same four results. For complex x, the power and exponential remain analytic on their natural domains; a logarithm requires a chosen local branch avoiding zero. This formulation is a proved extension of the real calculation, not an additional assumption about a real-valued loss.

Comparative cost and preferred method

For a single symbolic derivative the difference quotient and the local coefficient method have comparable fixed proof cost. No measured speed advantage is claimed. Once the four local rules are available, evaluation uses one power or exponential or one reciprocal, independently of a finite-difference step. A numerical difference quotient uses two function evaluations and division and supplies only an approximation; it does not meet the source's exact-proof requirement. The preferred solution here is the defining-limit proof.