Derivative

The derivative of a function of a real variable measures the sensitivity to change of a quantity (a function value or dependent variable) which is determined by another quantity (the independent variable) . Derivatives are a fundamental tool of calculus . For example , the derivative of the position of a moving object with respect to time is the object 's velocity : this measures how quickly the position of the object changes when time is advanced .

The derivative of a function of a single variable at a chosen input value , when it exists , is the slope of the tangent line to the graph of the function at that point . The tangent line is the best linear approximation of the function near that input value . For this reason , the derivative is often described as the " instantaneous rate of change " , the ratio of the instantaneous change in the dependent variable to that of the independent variable .

Derivatives may be generalized to functions of several real variables . In this generalization , the derivative is reinterpreted as a linear transformation whose graph is (after an appropriate translation) the best linear approximation to the graph of the original function . The Jacobian matrix is the matrix that represents this linear transformation with respect to the basis given by the choice of independent and dependent variables . It can be calculated in terms of the partial derivatives with respect to the independent variables . For a real @-@ valued function of several variables , the Jacobian matrix reduces to the gradient vector .

The process of finding a derivative is called differentiation . The reverse process is called antidifferentiation . The fundamental theorem of calculus states that antidifferentiation is the same as integration . Differentiation and integration constitute the two fundamental operations in single @-@ variable calculus .

Differentiation and derivative