

# Obtaining a spline function interpolating for any arbitrary node point $\mu$ ( $0 \leq \mu \leq 1$ ) and its applications

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**ABSTRACT:** Given some lacunary data values of the function  $y$ ,  $y'$  at node points and  $y'''$  at an arbitrary point  $\alpha$  ( $0 \leq \alpha \leq 1$ ), we obtained spline function  $S$  interpolating this function  $y$  and also convergent. This paper presents the construction of a quintic spline function for solving a lacunary interpolation problem with arbitrary intermediate node points. The spline interpolates the given function values at prescribed nodes together with specified derivative conditions at an arbitrary point within each subinterval. The proposed spline belongs to the continuity class  $C^4[0,1]$  and provides a smooth and unique interpolating approximation over the entire interval. Existence and uniqueness of the spline solution have been established through the derivation of a nonsingular system of equations for the spline coefficients. Further, convergence estimates of the spline and its derivatives have been obtained using modulus of continuity arguments and auxiliary lemmas. The developed interpolation technique extends earlier spline interpolation methods by allowing arbitrary node selection, thereby increasing flexibility and applicability in practical computational problems.

**KEYWORDS:** Interpolating function, Lacunary interpolation, spline functions, modulus of continuity.