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Asymptotic Normality and Berry-Esseen Type Bounds for Non-Stationary ϕ-Mixing Sequences with Exponential Decay

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We study triangular arrays of non-stationary random variables under exponential ϕ-mixing conditions. By developing block factorization inequalities and exploiting covariance bounds and characteristic function techniques, we establish a central limit theorem (CLT) and Berry-Esseen type bounds in this non-stationary dependent framework. Our results extend the classical theory beyond independence and stationarity, proving that exponential ϕ- mixing ensures asymptotic normality with the optimal convergence rate of order $O(n^{-1/2})$. These findings highlight the robustness of exponential ϕ-mixing as a tool for quantitative limit theorems and provide new methodological insights for analyzing dependent non-stationary data, with applications in probability, statistics, and time series analysis.

Keywords: ϕ-mixing, Central Limit Theorem, Berry-Esseen bound, asymptotic normality, non- stationary sequences.