# The Abel-Zeilberger Algorithm

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**Abstract:** By combining Abel ' s lemma on summation by parts with Zeilberger ' s algorithm, we give an algorithm, called the Abel-Zeilberger algorithm, to find recurrence relations for definite summations. The role of Abel ' s lemma can be extended to the case of linear difference operators with polynomial coefficients. This approach can be used to verify and discover identities involving harmonic numbers and derangement numbers. As examples, we use the Abel-Zeilberger algorithm to prove the Paule-Schneider identities, an identity of Andrews and Paule, and an identity of Calkin.

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**Keywords:** Abel's lemma, Zeilberger's algorithm, holonomic sequence, linear difference equation

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