



# Basic Hypergeometric Series and Applications (Mathematical Surveys and Monographs)

*Nathan J. Fine*

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The theory of partitions, founded by Euler, has led in a natural way to the idea of basic hypergeometric series, also known as Eulerian series. These series were first studied systematically by Heine, but many early results are attributed to Euler, Gauss, and Jacobi. Today, research in  $q$ -hypergeometric series is very active, and there are now major interactions with Lie algebras, combinatorics, special functions, and number theory. However, the theory has been developed to such an extent and with such a profusion of powerful and general results that the subject can appear quite formidable to the uninitiated. By providing a simple approach to basic hypergeometric series, this book provides an excellent elementary introduction to the subject. The starting point is a simple function of several variables satisfying a number of  $q$ -difference equations. The author presents an elementary method for using these equations to obtain transformations of the original function. A bilateral series, formed from this function, is summed as an infinite product, thereby providing an elegant and fruitful result which goes back to Ramanujan. By exploiting a special case, the author is able to evaluate the coefficients of several classes of infinite products in terms of divisor sums. He also touches on general transformation theory for basic series in many variables and the basic multinomial, which is a generalization of a finite sum. These developments lead naturally to the arithmetic domains of partition theory, theorems of Liouville type, and sums of squares. Contact is also made with the mock theta-functions of Ramanujan, which are linked to the rank of partitions. The author gives a number of examples of modular functions with multiplicative coefficients, along with the beginnings of an elementary constructive approach to the field of modular equations. Requiring only an undergraduate background in mathematics, this book provides a rapid entry into the field. Students of partitions, basic series, theta-functions, and modular equations, as well as research mathematicians interested in an elementary approach to these areas, will find this book useful and enlightening. Because of the simplicity of its approach and its accessibility, this work may prove useful as a textbook.

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