

# Commutation Relations, Normal Ordering, and Stirling Numbers (Discrete Mathematics and Its Applications)

Toufik Mansour, Matthias Schork



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**Commutation Relations, Normal Ordering, and Stirling Numbers** provides an introduction to the combinatorial aspects of normal ordering in the Weyl algebra and some of its close relatives. The Weyl algebra is the algebra generated by two letters U and V subject to the commutation relation UV - VU = I. It is a classical result that normal ordering powers of VU involve the Stirling numbers.

The book is a one-stop reference on the research activities and known results of normal ordering and Stirling numbers. It discusses the Stirling numbers, closely related generalizations, and their role as normal ordering coefficients in the Weyl algebra. The book also considers several relatives of this algebra, all of which are special cases of the algebra in which  $UV - qVU = hV^{\circ}$  holds true. The authors describe combinatorial aspects of these algebras and the normal ordering process in them. In particular, they define associated generalized Stirling numbers as normal ordering coefficients in analogy to the classical Stirling numbers. In addition to the combinatorial aspects, the book presents the relation to operational calculus, describes the physical motivation for ordering words in the Weyl algebra arising from quantum theory, and covers some physical applications.

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