# *ALGORITHMS FOR OPERATIONS ON PROBABILITY DISTRIBUTIONS IN A COMPUTER ALGEBRA SYSTEM*


## DIANE L. EVANS

College of William & Mary, Department of Applied Science, 2001
Field: Applied Mathematics, Degree: Ph.D.

Advisor: Charles. R. Johnson, Class of 1961 Professor of Mathematics



Abstract

In mathematics and statistics, the desire to eliminate mathematical tedium and facilitate exploration has led to computer algebra systems. These computer algebra systems allow students and researchers to perform more of their work at a conceptual level. The design of generic algorithms for tedious computations allow modelers to push current modeling boundaries outward more quickly.

Probability theory, with its many theorems and symbolic manipulations of random variables is a discipline in which automation of certain processes is highly practical, functional, and efficient. There are many existing statistical software packages, such as SPSS, SAS, and S-Plus that have numeric tools for statistical applications. There is a potential for a probability package analogous to these statistical packages for manipulation of random variables. The software package being developed as part of this dissertation, referred to as "A Probability Programming Language" (APPL) is a random variable manipulator and is proposed to fill a technology gap that exists in probability theory.

My research involves developing algorithms for the manipulation of discrete random variables. By defining data structures for random variables and writing algorithms for implementing common operations, more interesting and mathematically intractable probability problems can be solved, including those not attempted in undergraduate statistics courses because they were deemed too mechanically arduous. Algorithms for calculating the probability density function of order statistics, transformations, convolutions, products, and minimums/maximums of independent discrete random variables are included
in this dissertation.