

---

# **C/C++ Mathematical Algorithms for Scientists & Engineers**

**Namir C. Shammas**

**McGraw-Hill, Inc.**

New York San Francisco Washington, D.C. Auckland Bogotá  
Caracas Lisbon London Madrid Mexico City Milan  
Montreal New Delhi San Juan Singapore  
Sydney Tokyo Toronto

---

# Contents

<b>Introduction</b>	<b>xi</b>
<b>Chapter 1. Simultaneous Linear Equations</b>	<b>1</b>
The GLOBAL.H File	1
The General Vectors and Matrices	2
The Gauss-Jordan Elimination Method	7
The Gauss-Siedel Method	7
The LU Decomposition Method	7
The C Source Code	7
The C++ Source Code	17
The C Test Program	24
The C++ Test Program	28
<b>Chapter 2. Solving Nonlinear Equations</b>	<b>33</b>
The Bisection Method	34
Newton's Method	34
The Richmond Method	36
The Combined Method	37
Newton's Multirroot Method	37
Deflating Polynomial Method	38
The Lin-Bairstow Method	39
Solving Multiple Nonlinear Equations	40
Newton's Method for Multiple Equations	41
The C Functions	41
<b>Chapter 3. Interpolation</b>	<b>61</b>
The Lagrangian Interpolation	61
The Barycentric Interpolation	62
Newton's Divided Difference Interpolation	64
The Newton Difference Method	64
The Cubic Spline Interpolation Method	65
The C Source Code	66

<b>Chapter 4. Numerical Differentiation</b>	<b>75</b>
The Forward/Backward Difference Method	75
The Central Difference Method	76
The Extended Central Difference Method	77
The C Source Code	77
<b>Chapter 5. Numerical Integration</b>	<b>89</b>
Simpson's Method	89
Simpson's Alternate Extended Rule	90
The Gaussian Quadrature Methods	91
Gauss-Legendre Quadrature	91
The Gauss-Laguerre Quadrature	92
The Gauss-Hermite Quadrature	93
The Gauss-Chebyshev Quadrature	93
The Romberg Method	93
The C Source Code	94
<b>Chapter 6. Solving Ordinary Differential Equations</b>	<b>105</b>
The Runge-Kutta Method	105
The Runge-Kutta-Gill Method	106
The Runge-Kutta-Fehlberg Method	107
The C Source Code	108
<b>Chapter 7. Optimization</b>	<b>119</b>
The Bisection Method	119
Newton's Method	120
The Golden Section Search Method	121
The Quadratic Interpolation Method	121
The Cubic Interpolation Method	122
The Simplex Method	123
Newton's Method for Sequential Optimization	125
The C Source Code	125
The Test Program	134
<b>Chapter 8. Basic Statistics</b>	<b>139</b>
The Mean and Standard Deviation	139
The Confidence Intervals	140
The First Four Moments	140
Testing Sample Means	141
The C Source Code	142
The C++ Source Code	147
The C Test Program	151
The C++ Test Program	154
<b>Chapter 9. The ANOVA Tests</b>	<b>159</b>
The One-Way ANOVA	159
The Two-Way ANOVA	162

The Two-Way ANOVA with Replication	164
The Latin-Square ANOVA	167
The Analysis of Covariance	169
The C Source Code	172
The C++ Source Code	188
<b>Chapter 10. Linear Regression</b>	<b>203</b>
Basic Linear Regression	203
Linearized Regression	205
The Confidence Interval for Projections	206
The Confidence Interval for Regression Coefficients	206
The Regression Algorithms	207
The Automatic Best Fit	208
The C Source Code	208
The C++ Source Code	220
<b>Chapter 11. Multiple and Polynomial Regression</b>	<b>231</b>
Multiple Regression	231
The C Source Code	234
The C++ Source Code	243
The C Test Program	250
The C++ Test Program	254
Polynomial Regression	259
The C Source Code	259
The C++ Source Code	268
The C Test Program	275
The C++ Test Program	278
<b>Chapter 12. The Functions Library</b>	<b>283</b>
The STLIB Library	284
The Normal Distribution	284
The Inverse Normal Distribution	284
The Student-t Distribution	285
The Inverse Student-t Distribution	285
The F Distribution	285
The Inverse F Distribution	286
The Mathematical Functions Library	290
The Combination and Permutation Functions	290
The Gamma and Beta Functions	290
The Error Function	290
The Sine and Cosine Integral Functions	291
The Laguerre, Hermite, and Chebyshev Polynomials	291
The Bessel Functions	292
<b>Index</b>	<b>299</b>
<b>About the Author</b>	<b>305</b>
<b>Disk Instructions</b>	<b>308</b>