Table of contents for Industrial Mathematics:

Modeling in Industry, Science, and Government

| Preface | ix | |
|--------------------------|-------------|----|
| Acknowledgments | xii | |
| | | |
| Statistical Reasoning | | 1 |
| Random Variables | | 1 |
| Uniform Distributions | | 5 |
| Gaussian Distributions | | 6 |
| The Binomial Distributi | on | 7 |
| The Poisson Distribution | on | 10 |
| Taguchi Quality Contro | I | 12 |
| Exercises | | 16 |
| | | |
| The Monte Carlo Metho | bd | 21 |
| Computing Integrals | | 21 |
| Mean Time Between F | ailures | 23 |
| Servicing Requests | | 24 |
| The Newsboy Problem | (Reprise) | 27 |
| Exercises | | 28 |
| | | |
| Data Acquisition and M | anipulation | 31 |
| The z-Transform | | 31 |
| Linear Recursions | | 34 |
| Filters | | 36 |

| Stability | 39 |
|--------------------------------|-----|
| Polar and Bode Plots | 40 |
| Aliasing | 46 |
| Closing the Loop | 47 |
| Why Decibels? | 51 |
| Exercises | 53 |
| | |
| The Discrete Fourier Transform | 59 |
| Real Time Processing | 59 |
| Properties of the DFT | 61 |
| Filter Design | 63 |
| The Fast Fourier Transform | 66 |
| Image Processing | 70 |
| Exercises | 74 |
| | |
| Linear Programming | 77 |
| Optimization | 77 |
| The Diet Problem | 80 |
| The Simplex Algorithm | 81 |
| Exercises | 86 |
| | |
| Regression | 89 |
| Best Fit to Discrete Data | 89 |
| Norms on Rn | 93 |
| Hilbert Space | 94 |
| Gram's Theorem on Regression | 97 |
| Exercises | 101 |

| Cost-Benefit Analysis | 105 |
|--|-----|
| Present Value | 105 |
| Life-Cycle Savings | 106 |
| Exercises | 108 |
| | |
| Microeconomics | 111 |
| Supply and Demand | 111 |
| Revenue, Cost, and Profit | 113 |
| Elasticity of Demand | 115 |
| Duopolistic Competition | 116 |
| Theory of Production | 118 |
| Leontiev Input / Output | 119 |
| Exercises | 121 |
| | |
| Ordinary Differential Equations | 123 |
| Separation of Variables | 123 |
| Mechanics | 127 |
| Linear ODEs with Constant Coefficients | 130 |
| Systems | 135 |
| Exercises | 142 |
| | |
| Frequency-Domain Methods | 149 |
| The Frequency Domain | 149 |
| Generalized Signals | 153 |
| Plants in Cascade | 157 |
| Surge Impedance | 159 |

| Stability | 161 |
|--------------------------------|-----|
| Filters | 164 |
| Feedback and Root Locus | 169 |
| Nyquist Analysis | 173 |
| Control | 179 |
| Exercises | 184 |
| | |
| Partial Differential Equations | 191 |
| Lumped versus Distributed | 191 |
| The Big Six PDEs | 192 |
| Separation of Variables | 194 |
| Unbounded Spatial Domains | 213 |
| Periodic Steady State | 215 |
| Other Distributed Models | 217 |
| Exercises | 223 |
| | |
| Divided Differences | 231 |
| Euler's Method | 231 |
| Systems | 234 |
| PDEs | 235 |
| RungeKutta Method | 240 |
| Exercises | 240 |
| | |
| Galerkin's Method | 243 |
| Galerkin's Requirement | 243 |
| Eigenvalue Problems | 247 |
| Steady Problems | 249 |

| Transient Problems | 250 |
|----------------------------------|-----|
| Finite Elements | 252 |
| Why So Effective? | 259 |
| Exercises | 262 |
| | |
| Splines | 265 |
| Why Cubics? | 265 |
| m-Splines | 267 |
| Cubic Splines | 269 |
| Exercises | 274 |
| | |
| Report Writing | 277 |
| The formal Technical Report | 277 |
| The Memo | 282 |
| The Progress Report | 284 |
| The Executive Summary | 284 |
| The Problem Statement | 285 |
| Overhead Projector Presentations | 286 |
| Approaching a Writing Task | 287 |
| Style | 287 |
| Writer's checklist | 291 |
| | |
| References | 293 |
| Index | 299 |