

Orthogonal Polynomials in MATLAB

Exercises and Solutions

Walter Gautschi

Purdue University
West Lafayette, Indiana

siam.

Society for Industrial and Applied Mathematics
Philadelphia

Contents

Preface	vii
1 A Guide to the Software Packages OPQ and SOPQ	1
1.1 Recurrence relation	1
1.2 Chebyshev and modified Chebyshev algorithm	3
1.3 Discretization procedures	5
1.4 Modification algorithms	19
1.5 Sobolev orthogonal polynomials	27
1.6 Quadrature formulae	31
2 Answers to Exercises on Orthogonal Polynomials	35
2.1 Elementary properties	36
2.2 Symmetry	44
2.3 Orthogonality on two separate (symmetric) intervals	48
2.4 Modified and classical Chebyshev algorithm	58
2.5 Discretization method	120
2.6 Modification algorithms	135
3 Answers to Exercises on Sobolev Orthogonal Polynomials	157
3.1 Elementary properties	158
3.2 Symmetry	161
3.3 Zeros	162
4 Answers to Exercises on Quadrature	181
4.1 Elementary properties	183
4.2 Cauchy and Cauchy principal value integrals	188
4.3 Gauss–Radau and Gauss–Lobatto quadrature	195
4.4 Gauss–Kronrod quadrature	213
4.5 Gauss–Turán quadrature	214
4.6 Polynomial/rational quadrature formulae of Gaussian type	215
4.7 Quadrature estimates of matrix functionals	216
5 Answers to Exercises on Approximation	235
5.1 Special functions	236
5.2 Polynomial least squares approximation	259
5.3 Moment-preserving approximation	272
5.4 Summation by integration	275
5.5 The spiral of Theodorus	288

A	The Software Package OPQ (Orthogonal Polynomials and Quadrature)	293
A.1	Orthogonal polynomials	293
A.2	Quadrature	303
A.3	Examples and tests	308
A.4	Tables and figures	310
A.5	Utility	312
B	The Software Package SOPQ (Symbolic Orthogonal Polynomials and Quadrature)	317
B.1	Orthogonal polynomials	317
B.2	Quadrature	320
B.3	Utility	321
	Bibliography	323
	Software Index	327
	Subject Index	331