

Contents

Part I Mathematics of Distances

1	General Definitions	3
1.1	Basic definitions	3
1.2	Main distance-related notions	11
1.3	Metric numerical invariants.....	19
1.4	Metric mappings.....	30
1.5	General distances.....	40
2	Topological Spaces	59
3	Generalizations of Metric Spaces.....	67
3.1	m -metrics	67
3.2	Indefinite metrics	68
3.3	Topological generalizations	69
3.4	Beyond numbers.....	72
4	Metric Transforms	79
4.1	Metrics on the same set.....	79
4.2	Metrics on set extensions	82
4.3	Metrics on other sets	85
5	Metrics on Normed Structures	89

Part II Geometry and Distances

6	Distances in Geometry.....	103
6.1	Geodesic Geometry.....	103
6.2	Projective Geometry	110
6.3	Affine Geometry	115
6.4	Non-Euclidean Geometry	117

7	Riemannian and Hermitian Metrics	127
7.1	Riemannian metrics and generalizations.....	128
7.2	Riemannian metrics in Information Theory	143
7.3	Hermitian metrics and generalizations.....	148
8	Distances on Surfaces and Knots	161
8.1	General surface metrics	161
8.2	Intrinsic metrics on surfaces	167
8.3	Distances on knots	170
9	Distances on Convex Bodies, Cones, and Simplicial Complexes	173
9.1	Distances on convex bodies.....	173
9.2	Distances on cones	179
9.3	Distances on simplicial complexes.....	181
 Part III Distances in Classical Mathematics		
10	Distances in Algebra	187
10.1	Group metrics	187
10.2	Metrics on binary relations	196
10.3	Metrics on lattices.....	197
11	Distances on Strings and Permutations	201
11.1	Distances on general strings	202
11.2	Distances on permutations	210
12	Distances on Numbers, Polynomials, and Matrices	215
12.1	Metrics on numbers	215
12.2	Metrics on polynomials	220
12.3	Metrics on matrices	221
13	Distances in Functional Analysis	229
13.1	Metrics on function spaces.....	229
13.2	Metrics on linear operators	236
14	Distances in Probability Theory	241
14.1	Distances on random variables	242
14.2	Distances on distribution laws.....	243
 Part IV Distances in Applied Mathematics		
15	Distances in Graph Theory	257
15.1	Distances on vertices of a graph.....	258
15.2	Distance-defined graphs.....	264

15.3 Distances on graphs	271
15.4 Distances on trees	278
16 Distances in Coding Theory	285
16.1 Minimum distance and relatives	286
16.2 Main coding distances	289
17 Distances and Similarities in Data Analysis	297
17.1 Similarities and distances for numerical data	298
17.2 Relatives of Euclidean distance	301
17.3 Similarities and distances for binary data	304
17.4 Correlation similarities and distances.....	307
18 Distances in Mathematical Engineering	311
18.1 Motion planning distances	311
18.2 Cellular automata distances	315
18.3 Distances in Control Theory	316
18.4 MOEA distances	318
Part V Computer-related Distances	
19 Distances on Real and Digital Planes	323
19.1 Metrics on real plane.....	323
19.2 Digital metrics	332
20 Voronoi Diagram Distances	339
20.1 Classical Voronoi generation distances.....	340
20.2 Plane Voronoi generation distances	342
20.3 Other Voronoi generation distances.....	346
21 Image and Audio Distances.....	349
21.1 Image distances.....	349
21.2 Audio distances.....	362
22 Distances in Internet and Similar Networks	371
22.1 Scale-free networks	371
22.2 Network-based semantic distances	374
22.3 Distances in Internet and Web	376
Part VI Distances in Natural Sciences	
23 Distances in Biology	385
23.1 Genetic distances for gene-frequency data.....	387
23.2 Distances for DNA/RNA data	391

23.3 Distances for protein data	400
23.4 Other biological distances	404
24 Distances in Physics and Chemistry	419
24.1 Distances in Physics	419
24.2 Distances in Chemistry and Crystallography	436
25 Distances in Geography, Geophysics, and Astronomy	445
25.1 Distances in Geography and Geophysics	445
25.2 Distances in Astronomy	456
26 Distances in Cosmology and Theory of Relativity	465
26.1 Distances in Cosmology	465
26.2 Distances in Theory of Relativity	473
 Part VII Real-world Distances	
27 Length Measures and Scales	495
27.1 Length scales	495
27.2 Orders of magnitude for length	503
28 Distances in Applied Social Sciences	509
28.1 Distances in Psychology and Sociology	509
28.2 Distances in Economics and Human Geography	514
28.3 Distances in Perception, Cognition and Language	522
28.4 Distances in Philosophy, Religion and Art	530
29 Other distances	537
29.1 Distances in Medicine, Antropometry and Sport	537
29.2 Equipment distances	546
29.3 Miscellany	554
References	563
Index	571