

Contents

Preface	xi
Chapter 1. Introduction	1
1.1. Discrete-time population models	1
1.2. The spectral radius of a bounded homogeneous operator	2
1.3. Preview of extinction and persistence results	3
1.4. Continuous dependence of the spectral radius on its operator	6
1.5. The spectral radius as (lower) eigenvalue	6
1.6. Turnover versus reproduction number	7
1.7. Case studies in population dynamics	8
1.8. Other aspects of population dynamics	10
Chapter 2. Cones and ordered vector spaces	11
2.1. Wedges, cones, and associated orders	11
2.2. Normal and (fully) regular cones	18
2.3. Generating, total and non-flat wedges	22
2.4. The space of sequences of bounded variation: a choice of cones	25
2.5. Monotone half-norm and companion norm	29
2.6. How orders create norms	33
2.7. The ordered vector space of (Lipschitz) continuous functions	40
Chapter 3. The ordered vector space of real measures	49
3.1. Measures under the variation norm	51
3.2. Measures on a metric space under the flat norm	51
Chapter 4. Homogeneous operators	73
4.1. Operator norm for homogeneous operators	73
4.2. Order-preserving operators and the companion norm	75
4.3. Duality for ordered normed vector spaces	77
4.4. Important homogeneous functionals	80
4.5. Mating functions	82
Chapter 5. Spectral radii for homogeneous operators	87
5.1. Spectral radius and orbital spectral radius	87
5.2. Compatibility of the spectral radius under linear extension	96
5.3. A series characterization of the spectral radius	99
5.4. Upper estimates for growth factors	101
5.5. Collatz–Wielandt spectral radius	103
5.6. Estimates of the spectral radius involving functionals	106
5.7. Cartesian products	107

Chapter 6. Order-bounded operators	109
6.1. Properties	109
6.2. Upper Collatz–Wielandt numbers and radii	110
6.3. The upper Collatz–Wielandt bound	114
6.4. Iterative calculation of the spectral radius	117
6.5. Monotonicity of spectral radii and Collatz–Wielandt bounds	118
Chapter 7. Upper semicontinuity of spectral radii	121
7.1. Upper semicontinuity with respect to the operator norm	121
7.2. More upper semicontinuity results	126
Chapter 8. A left resolvent for homogeneous operators	131
Chapter 9. Eigenvectors of (pseudo-)compact homogeneous operators	137
9.1. Compact operators	140
9.2. Pseudo-compact operators	144
Chapter 10. Continuity of the spectral radius	149
10.1. Continuity of the spectral radius for bounded linear maps with compact powers	149
10.2. Lower semicontinuity of the lower Collatz–Wielandt bound	150
10.3. Continuity of spectral radii and CW bounds	151
10.4. Lower semicontinuity may fail	154
Chapter 11. Eigenfunctionals	161
11.1. Preparations	161
11.2. Eigenfunctionals for maps with CW and lower KR property	163
11.3. Eigenfunctionals for normal cones	166
11.4. Eigenfunctionals if there is no norm	168
11.5. Continuity of homogeneous order-preserving eigenfunctionals	170
11.6. An example by Bonsall	171
11.7. Strict monotonicity of eigenfunctionals	174
Chapter 12. Turnover versus reproduction number	177
12.1. The next generation operator	177
12.2. Both operators additive	178
12.3. Additive perturbations of homogeneous rank-one operators	179
Chapter 13. Linear maps on the vector space of measures	185
13.1. Multiplication maps	185
13.2. Linear maps induced by measure kernels	188
13.3. Feller kernels	192
13.4. Tight measure kernels	199
13.5. Eigenmeasures of tight Feller kernels	203
13.6. Uniform Feller kernels and their eigenfunctions	204
13.7. Irreducible, sustaining, and colonization kernels	208
13.8. Continuous dependence of the spectral radius on kernels	217
Chapter 14. Nonlinear dynamics	221
14.1. Homogeneous maps as derivatives	221
14.2. (Lower and upper) order derivatives	221

14.3.	Partial stability and persistence results	223
14.4.	Local asymptotic stability of the extinction state in the subthreshold case	226
14.5.	Local stability of the extinction state in the threshold case	227
14.6.	Point-dissipativity and compact attractors	227
14.7.	Population extinction	232
14.8.	Nonzero fixed points	234
14.9.	Population persistence	236
Chapter 15.	Unstructured population models	241
15.1.	A very basic two-sex population model	241
15.2.	A simple two-sex population model in hybrid time	246
Chapter 16.	A rank-structured population with mating	253
16.1.	The model equations and well-posedness	253
16.2.	A basic reproduction number	257
16.3.	The basic reproduction number as threshold parameter	259
Chapter 17.	Two diffusing sexes and short reproductive season	263
17.1.	The model	263
17.2.	Proof of main result	266
17.3.	Basic turnover number and critical domain size	271
17.4.	More on persistence	273
17.5.	Point-dissipativity	274
17.6.	Order permanence	275
Chapter 18.	Nonlocal spatial spread of semelparous two-sex populations	277
18.1.	A recursive equation for population densities	277
18.2.	Reproduction and mating	279
18.3.	The basic turnover operator	280
18.4.	Stability and instability results	283
18.5.	Uniform weak persistence	284
18.6.	Population survival and sex-biased dispersal	286
Chapter 19.	Populations with measure-valued structural distributions	295
19.1.	A recursive equation for measures	295
19.2.	Habitats that are just measurable spaces	296
19.3.	Habitats that are metric spaces	298
19.4.	A more general framework	307
19.5.	A homogeneous operator on the cone of nonnegative measures	308
Appendix A.	Some tools from real analysis	311
A.1.	Metric spaces	311
A.2.	The extended real numbers	319
A.3.	Sequences	320
A.4.	Semicontinuous functions	322
Bibliography		327
Index		339