Contents

Preface

Part 1 The context

Chapter 1 The structure of the argument 2

Chapter 2 Examples of population models 4
- 2.1 Introduction
- 2.2 The closed-system cohort survival model
- 2.3 The open-system single-region cohort survival model
- 2.4 The multi-region cohort survival model
- 2.5 The problem of rate measurement

Part 2 Accounts and models for multi-region aggregate populations

Chapter 3 Principles of accounting 18
- 3.1 Introduction
- 3.2 Accounts
- 3.3 Basic population accounts
- 3.4 Use of accounting equations
- 3.5 Summary of results for the standard case

Chapter 4 'At-risk' populations 29
- 4.1 The concept, and a basic assumption
- 4.2 At-risk populations for births
- 4.3 At-risk populations for deaths
- 4.4 At-risk populations for migration
- 4.5 The use of at-risk population concepts: preliminary discussion

Chapter 5 An account-based model for the aggregate case 36
- 5.1 Procedures for estimating unknown minor flows from known data. 1: the standard case
- 5.2 A note on surviving infant migrants
- 5.3 Procedures for estimating unknown minor flows from known data. 2: the non-standard cases
- 5.4 An account-based model
- 5.5 Uses of the account-based model: historical analyses and future projections
- 5.6 A note on appropriate non-iterative forms of account-based model

Chapter 6 The transition rate form of the model 45
- 6.1 Basic principles
- 6.2 Application to the demographic model
- 6.3 Some comments

Chapter 7 An example 54
7.1 Introduction
7.2 Regions
7.3 The population accounts table in conceptual form
7.4 Data availability and the time period adopted
7.5 Estimation of known flows and stocks from data
7.6 Initial populations
7.7 Deaths
7.8 Births
7.9 'Migration and survival' flows
7.10 'Birth and migration' flows
7.11 Concluding comments on the estimation of flows and stocks
7.12 A worked example of the account-based model for an historical period
7.13 Projection using the transition rate model
7.14 Concluding comments

Part 3 Accounts and models for multi-region age–sex disaggregated populations

Chapter 8 Principles of age and sex disaggregation 88
8.1 Introduction: notational developments
8.2 Ageing
8.3 Structure of Part 3

Chapter 9 Age–sex disaggregated accounts 93
9.1 Outline of the accounts for the general case
9.2 A preliminary classification of age-group types
9.3 The accounting equations
9.4 Coefficients which relate variables within submatrices
9.5 Revision of accounting equations
9.6 An alternative presentation of the accounting equations
9.7 Accounting equations for the simple case
9.8 A note on sex

Chapter 10 Age–sex disaggregated at-risk populations 111
10.1 Introduction: the at-risk populations needed
10.2 Principles of calculation and main results
10.3 At-risk populations in the simple case

Chapter 11 An account-based model for age–sex disaggregated populations 114
11.1 Estimation of unknown minor flows
11.2 A note on migrating, surviving infants
11.3 An account-based model
11.4 The account-based model used for projection
11.5 The account-based model for the simple case
11.6 Disaggregation by sex
11.7 Possible approximate non-iterative forms of the model

Chapter 12 The transition rate form of the models in the disaggregated case, and connections to the Rogers and Stone models 131
12.1 The general case
12.2 The simple case
12.3 Disaggregation by sex
12.4 Comparison with the Rogers model
12.5 Comparison with Stone's accounts and models
12.6 Concluding comments

Chapter 13 Examples 158
13.1 Introduction
13.2 A set of age-disaggregated accounts: example 3
13.3 The structure of a set of expanded age-disaggregated accounts
13.4 The account-based model applied to Middle Earth
13.5 Rates associated with accounts tables
13.6 Projection models
13.7 Example 4: brief notes on a real-world, simple case example for the West Riding of Yorkshire
13.8 Example 5: brief notes on a real-world, general case example for East and West Hunslet
13.9 Concluding comments

Part 4 Multi-region account-based life tables

Chapter 14 Life-table accounts 216
14.1 Introduction
14.2 A review of rate definitions, and the introduction of life-table rates
14.3 Life-table accounts
14.4 Connections to conventional life-table rates

Chapter 15 A life-table account-based model 230
15.1 Summary of the main steps
15.2 The model

Chapter 16 Multi-regional account-based life tables 237
16.1 The closed-system life table
16.2 The multi-regional exact-age life table
16.3 Models associated with the life table
16.4 The connections between life-table accounts and age-group accounts
16.5 Age group life tables
16.6 Concluding comments

Part 5 Conclusions

Chapter 17 A summary of methods, potential applications and connections to other and ongoing work 278

17.1 Summary of methods introduced
17.2 Potential applications
17.3 Connections to other work
17.4 Connections to ongoing work

Appendixes

Appendix 1 The estimation of migration flows for the aggregate case example 282
A1.1 'Migration and survival' flows
A1.2 'Birth and migration' flows

Appendix 2 Calculation of p_{rs}, q_{rs}, c_{rs} and π_s coefficients 295
A2.1 Survival coefficients
A2.2 Death coefficients
A2.3 Birth coefficients

Appendix 3 Use of aggregation and disaggregation matrix operators 306
A3.1 Definitions
A3.2 Survival coefficients
A3.3 Death coefficients

Appendix 4 Age–sex disaggregated at-risk populations: detailed calculations 311
A4.1 Introduction
A4.2 The main accounts at-risk population for births
A4.3 At-risk population for deaths
A4.4 The birth accounts at-risk population for births
A4.5 Populations at risk in the simple case
A4.6 Summary
A4.7 Disaggregation by sex

Appendix 5 The calculation of θ and ψ coefficients 332

Appendix 6 Models with time as a continuous variable 336

Appendix 7 Calculation of a set of expanded birth accounts and the birth section of the accounts for the multi-regional cohort survival model 338

References and further reading 347

Index 351