Demographic Analysis

Mortality:

Model Life Tables

Model Life Tables

In this lesson we will discuss:

- The concept behind model life tables
- Their usefulness as a tool in mortality analysis
- How they allow us to use small amounts of mortality data to map a broader picture of mortality conditions
- Software for constructing model life tables and for evaluating choices among various model options

What is a Model Life Table?

Model life tables are life tables that are usually based on observed data in actual countries. The first models were developed by the United Nations in the 1950s.

Model life tables are very useful in providing estimates of overall mortality conditions in countries for which vital registration is incomplete or of lesser quality.

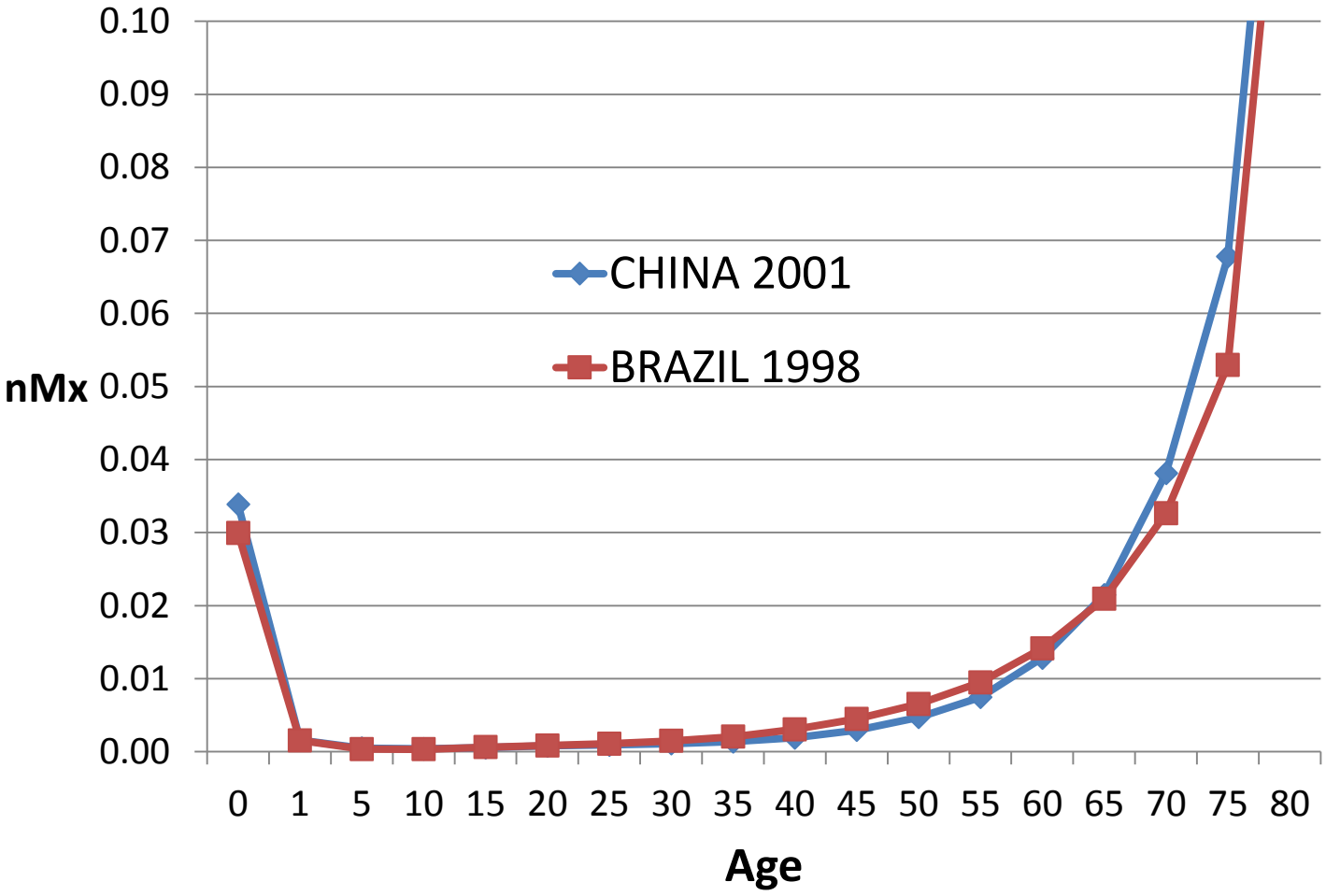
They are also often used to “leverage” partial information. For instance, one can estimate an entire life table based on a *single* estimate of infant mortality (e.g. using MATCH).

The Concept Behind Model Life Tables

Typically, model life tables have been derived from a group of countries presumed to have high quality data and which share distinctive age-patterns of mortality. What do we mean by distinctive age patterns?

Remember that a particular level of life expectancy is consistent with any number of *different age* patterns of mortality. For instance, if two countries have the same life expectancy, one country might have both higher infant mortality and lower adult mortality than the other country.

Female Age-Specific Death Rates for Two Countries Where Life Expectancy at Birth was 72.8

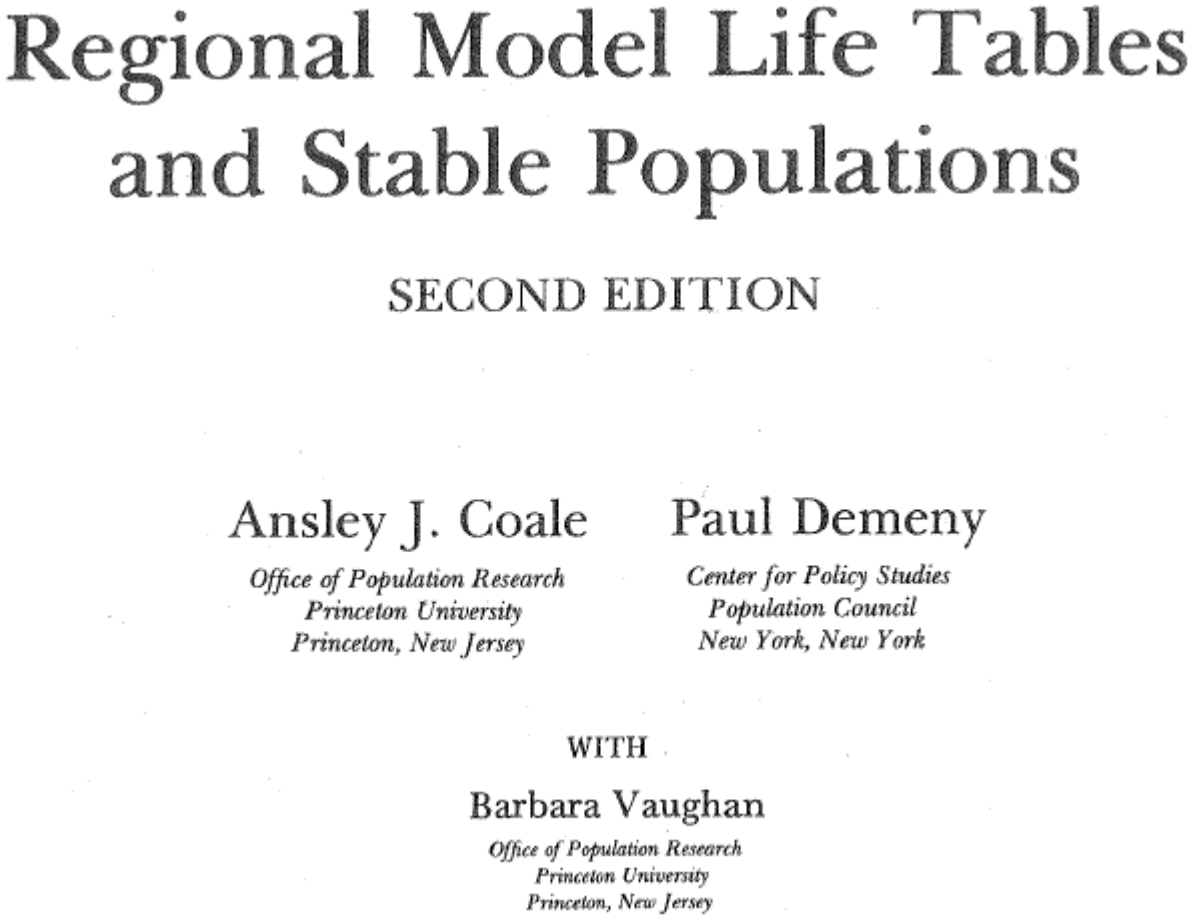


The Coale-Demeny Regional Model Life Tables

A set of model life tables was developed by Coale and Demeny (1968) in the 1960's. These models classify the life tables into four different sets, labeled West, East, North, and South, according to the patterns of mortality in the predominant regions of Europe represented in the original data.

In each of these sets, the life expectancy at age 10 was correlated with the probability of dying at different ages, and these correlations provided the basis for estimating a series of “nested” life tables at different overall levels of e(x) but with different age patterns of mortality.

The Coale-Demeny Regional Model Life Tables



Regional Model Life Tables and Stable Populations

SECOND EDITION

Ansley J. Coale
Office of Population Research
Princeton University
Princeton, New Jersey

Paul Demeny
Center for Policy Studies
Population Council
New York, New York

WITH

Barbara Vaughan
Office of Population Research
Princeton University
Princeton, New Jersey

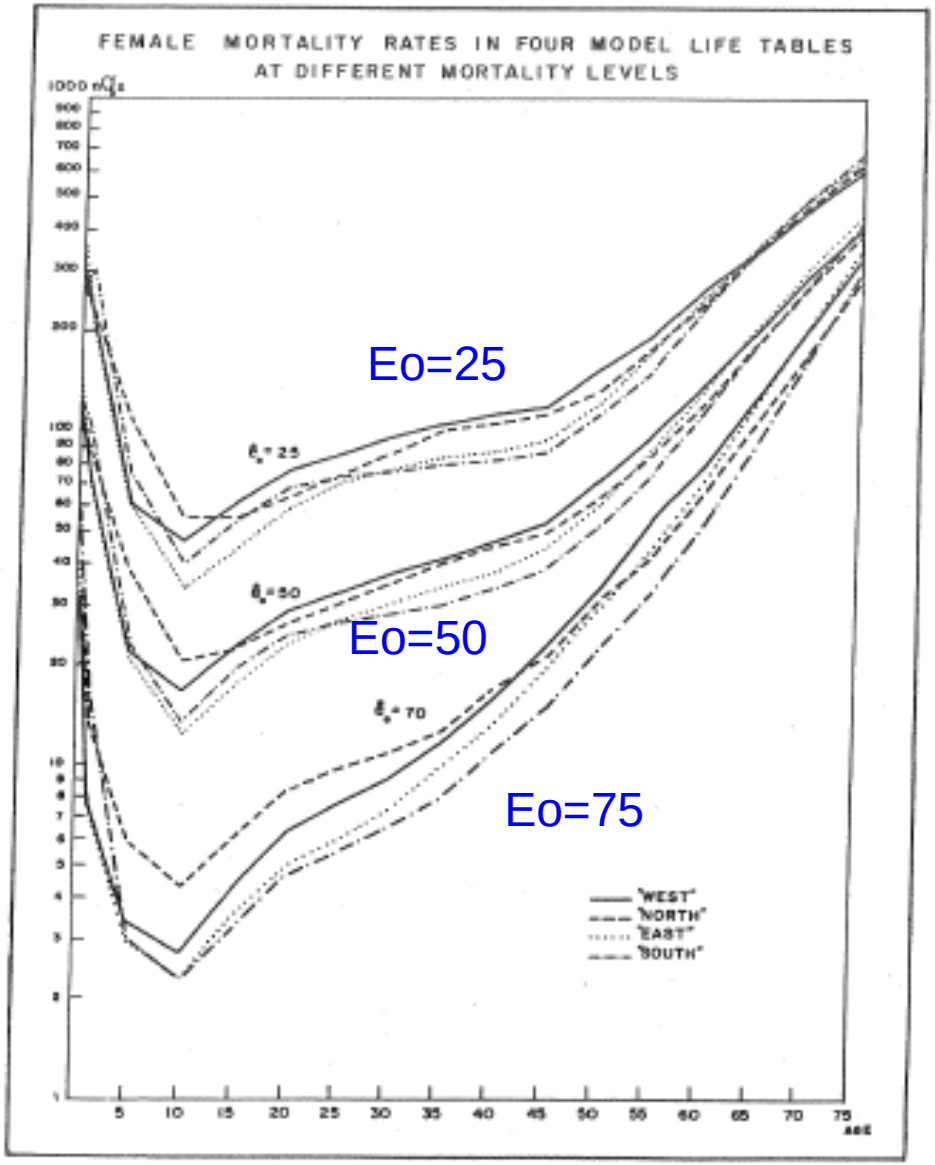
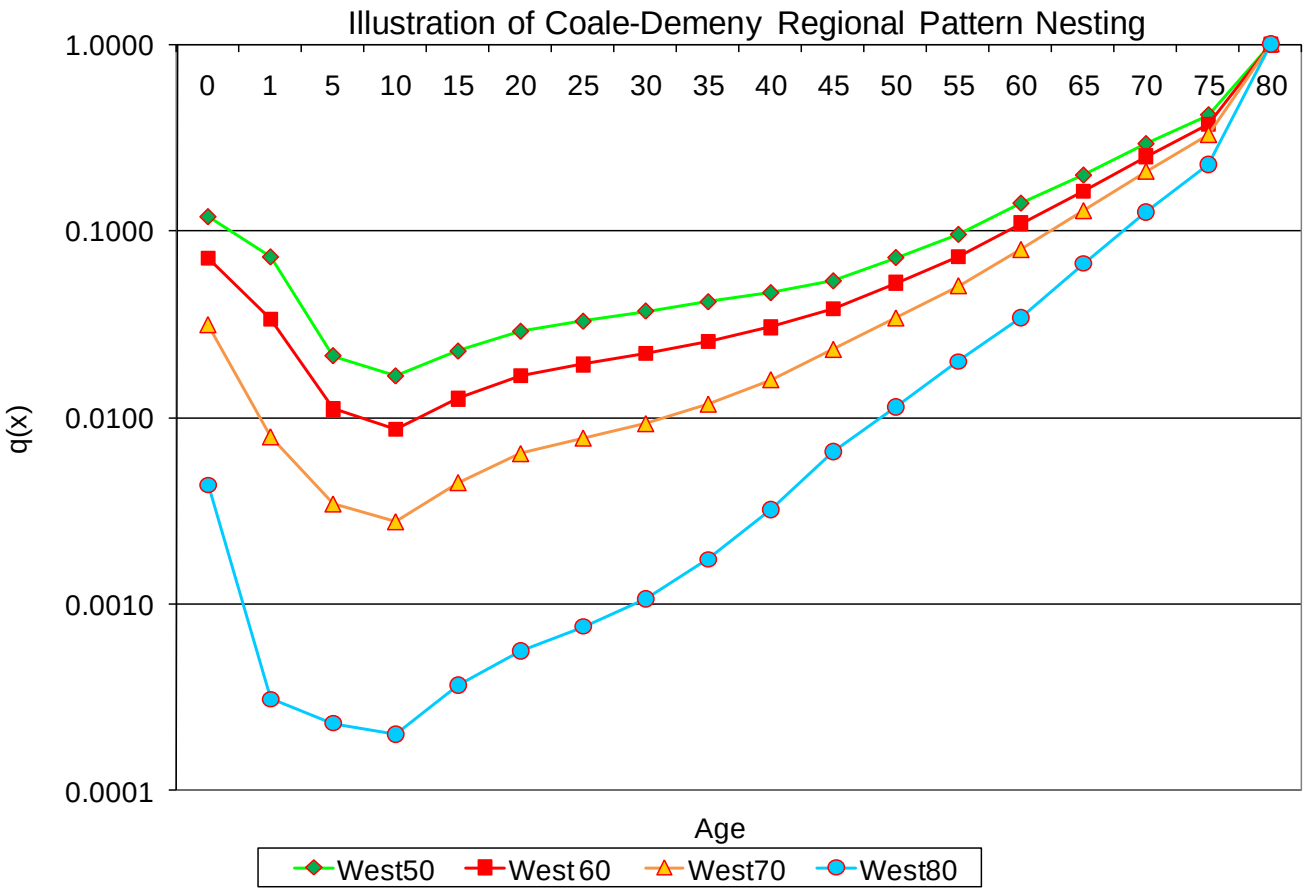


FIGURE 3. Values of $_nq_x$ in the four families of model life tables ("West," "North," "East," and "South") when e_0^0 = 25, 50, and 70 years, for females.

“Nested” Age-specific Mortality Within the West Coale-Demeny MLT (Eo varies from 50 to 80 Years)



Brass' General Standard and African Standard

At about the same time as the Coale-Demeny models appeared, William Brass (Brass et al., 1968) developed the General Standard Model. In this model, life tables are related by a two-parameter logit system, based on a general pattern of mortality and a linear relationship between two sets of logits. By changing the two parameters of the linear relationship, the general pattern is changed in relation to the level and pattern of mortality.

Brass also introduced his African Standard in the same book. The African Standard differs from the General Standard by its relatively high childhood mortality *vis a vis* infant mortality (Brass et al., 1968:113).

Why Differences in Age Patterns of Mortality Exist?

If countries have the same life expectancy, why might their age pattern of mortality differ?

- Broad environmental factors (climate, natural disasters, crop productivity, etc.)
- Disease vectors (tuberculosis, malaria, HIV, etc.) and other causes of death
- Public health spending and interventions may benefit certain demographic groups

The Coale-Demeny Stable Population Models

Coale-Demeny, in addition to developing regional model life tables, also derived stable populations corresponding to each of the four regions. Stable populations occur when mortality and fertility are constant and there is no migration.

Stable populations were derived based on various combinations of mortality and fertility and have useful applications in demographic analysis.

The (New) United Nations Model Life Tables

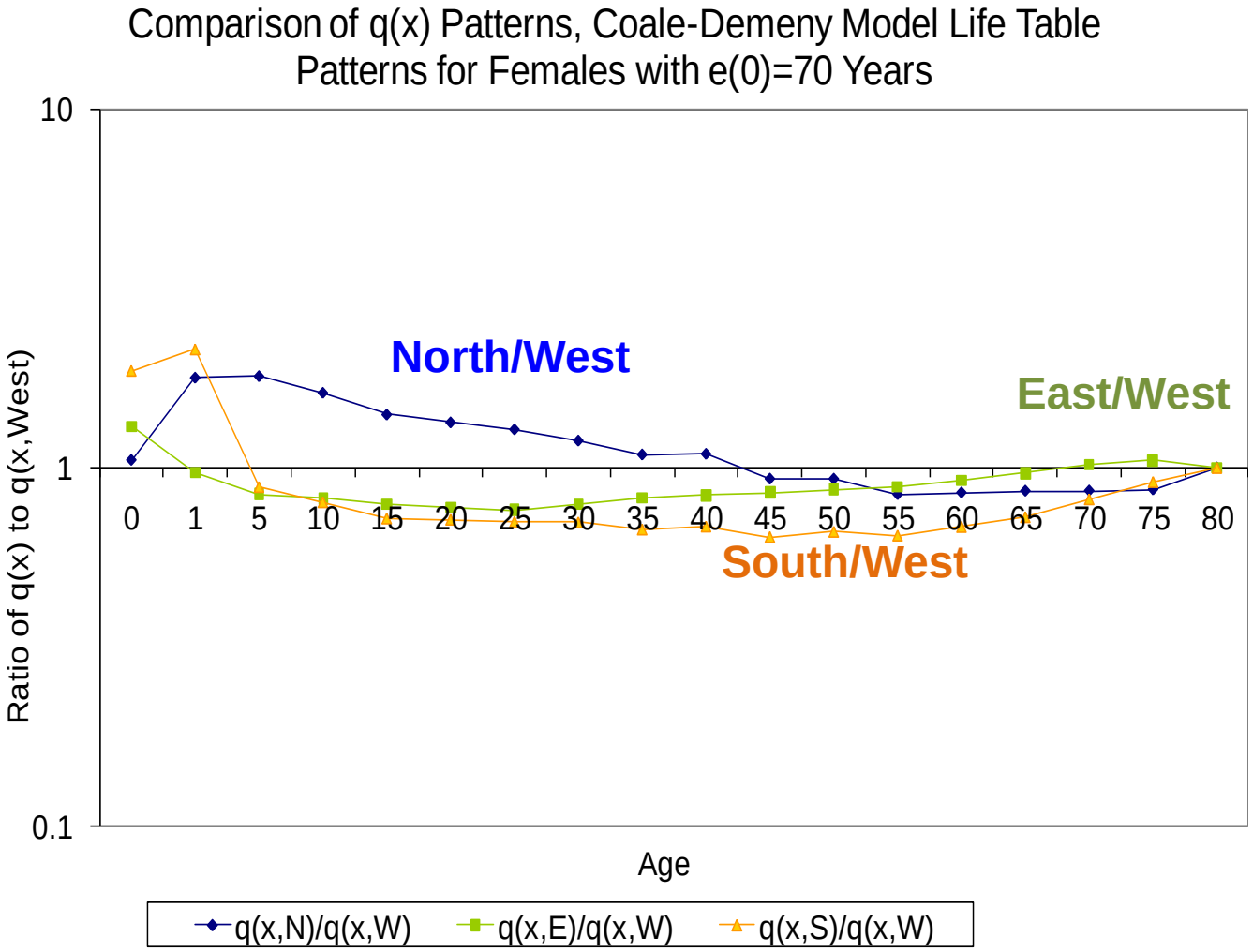
Most of the empirical life tables used in constructing the models described above pertained to developed countries. In the 1980s, the United Nations published a new set of life table models, based on the mortality experience of developing countries with reliable information (Heligman, 1984 and United Nations, 1982).

Empirical life tables for developing countries were grouped into four sets, plus a general set including all of them. These sets are referred to as the Latin American, Chilean, South Asian, Far Eastern, and General patterns.

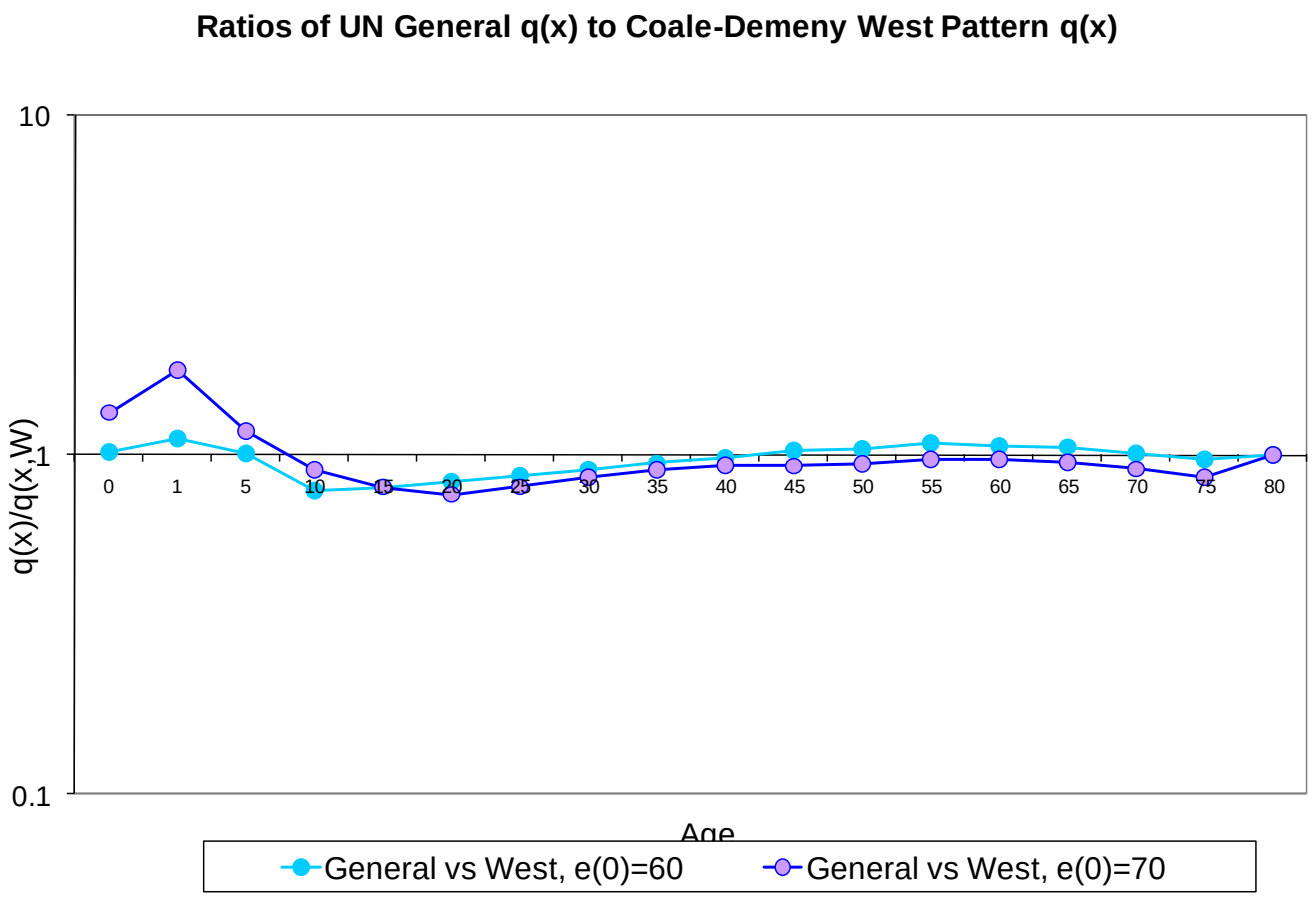
Comparing Age Differences Across Model Life Tables

The following figures indicate relative differences in mortality by age implied by various model life table families. Note again that age patterns will differ even when overall life expectancy is the same.

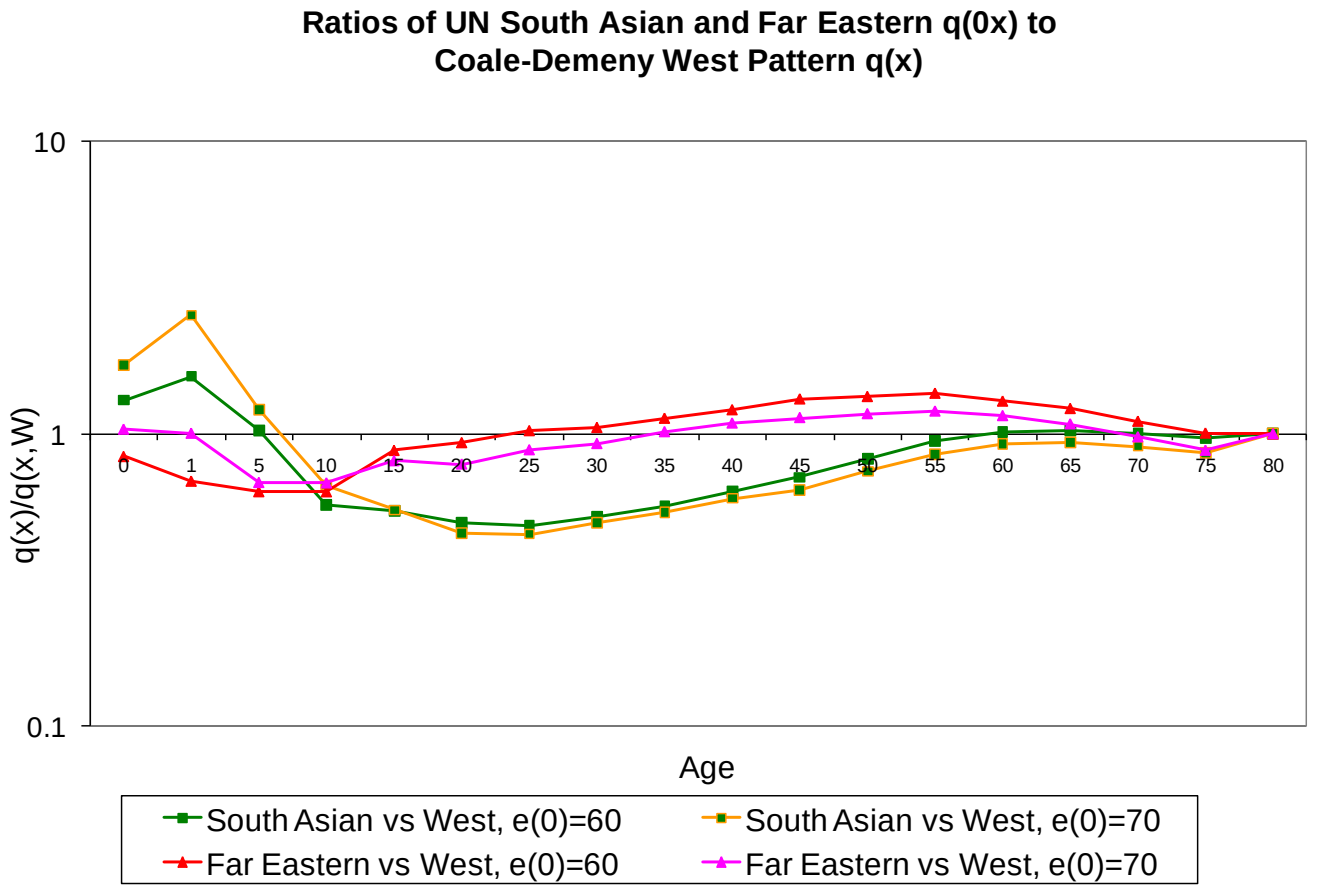
Ratio of Age-Specific Mortality Between Coale-Demeny Regions and West



Ration of United Nations General Model and Coale-Demeny West Model



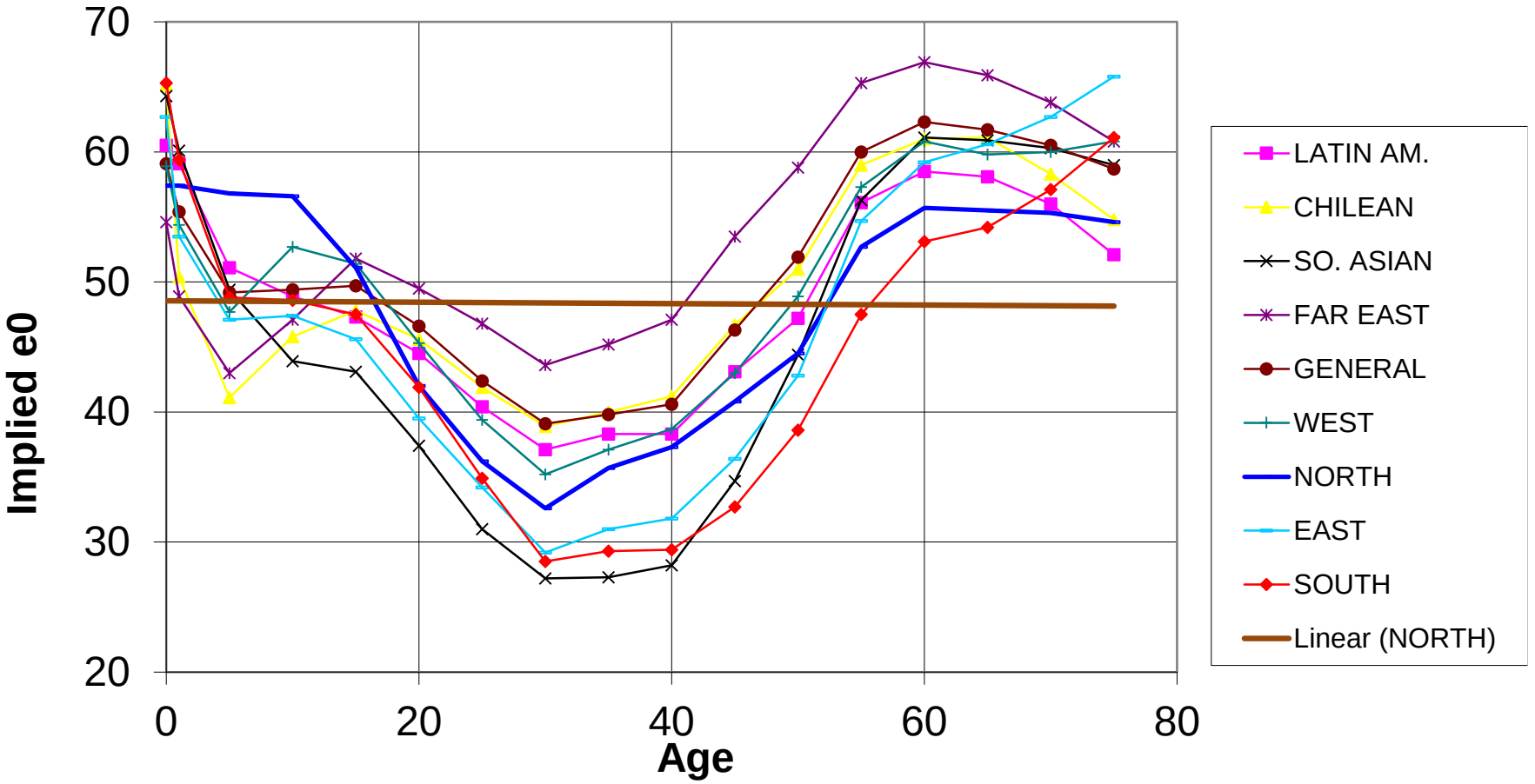
United Nations and Coale-Demeny West MLT Patterns Compared, Females at e(0) = 60 & 70 Years



Issues with Model Life Tables - AIDS

Model life tables were developed prior to the onset of AIDS, which causes age-patterns of mortality that are quite different from available models – an implied increase in mortality (reduced life expectancy) among young and middle aged adults. See the following graphic.

Life Expectancy at Birth Implied by Mortality by Age for an African Country



Issues with Model Life Tables - AIDS

- Attempts to infer overall life expectancy based on infant mortality in a country where AIDS is prevalent may underestimate the overall mortality conditions.
- Model life tables are used to estimate non-AIDS mortality for countries with severe HIV/AIDS epidemics, mainly in sub-Saharan Africa. AIDS-related mortality is estimated using mathematical modeling techniques and epidemiological data.

Mathematical Modeling of HIV/AIDS Epidemic

- Estimate of national-level HIV prevalence
  - HIV prevalence among pregnant women attending antenatal clinics.
  - HIV prevalence by sex from national surveys (e.g., DHS).
- Adult anti-retroviral coverage.
- Coverage of treatment to prevent mother-to-child HIV transmission.
- Age and sex patterns of incident infections.
- The result is estimates of AIDS-related deaths used to calculate AIDS-related central death rates. These are combined with the non-AIDS model life table rates to get overall mortality for the country.

Data to Consider in Developing and/or Validating Mortality Patterns

- Census data
  - Deaths in the last 12 months.
- Demographic and Health survey data (DHS)
  - Infant and child mortality.
  - Sibling/orphanhood data.
- Other survey data.
- Demographic surveillance data, if available.
- Vital statistics.

Software Dealing with Model Life Tables

- MORTPAK: MATCH
  - Find a model life table from a particular model pattern that matches a given input ($_nm_x$, $_nq_x$, l_x, or e_x).
- MORTPAK: COMPAR
  - Compute the life expectancy implied by each $_nm_x$ or $_nq_x$ for each of several model patterns.
- NewPAS: ComparNewA.xls
  - Plot implied e_0 values from COMPAR

Software Dealing with Model Life Tables

- MORTPAK: BESTFT
  - Estimate the level of mortality from a given model life table that has values closest to ${}_nq_x$ values for selected ages.
- PAS:LTWST.xls,LTNTH.xls, and LTSTH.xls
  - Estimate the given model life table needed to reproduce the CDR (by sex if available) given the population by age and sex.

Exercises

- Use COMPAR with estimated ${}_nm_x$ or ${}_nq_x$ to see which model life table pattern seems closest to your data.
    - Do the patterns possibly indicate the impact of AIDS on adult mortality?
- Using estimated mortality at some age group generate an entire life table using MATCH. See how different the results are if you choose a different model