Estimating NTA Lifecycle Account Age Profiles

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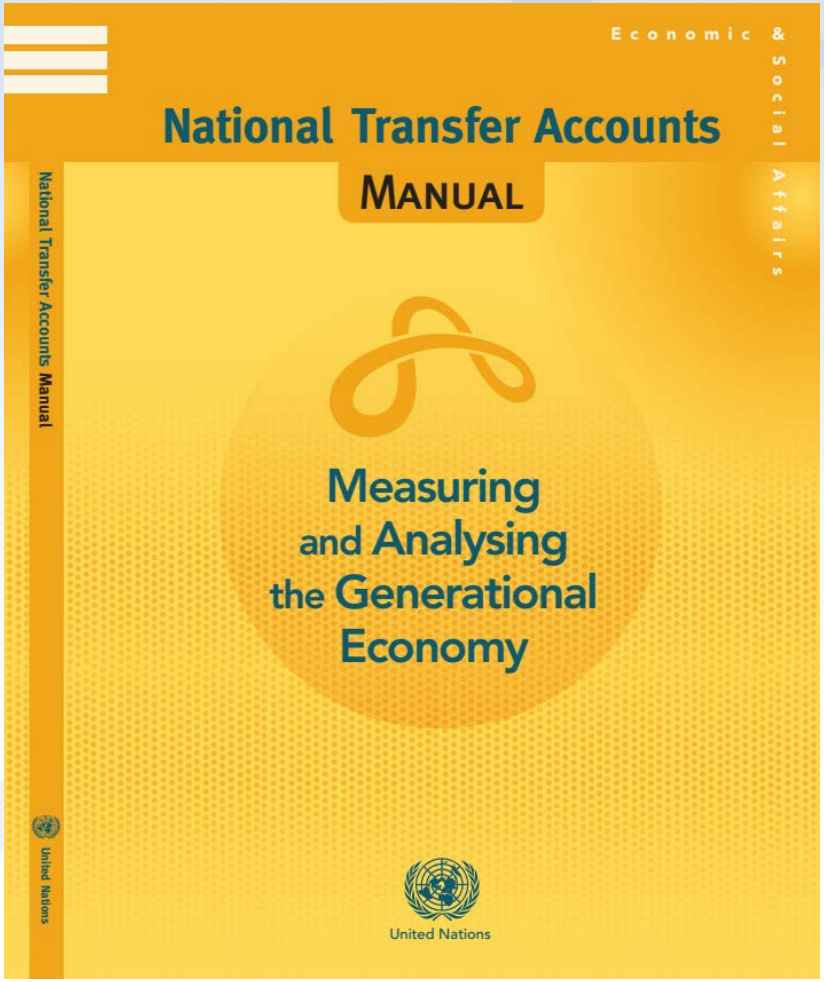
Reference



United Nations (2013). National Transfer Accounts Manual. Measuring and Analysing the Generational Economy. Chapter 5.

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NTA flow identity

$$\underbrace{C(x)-Y^{l}(x)}_{\text{Lifecycle Deficit}}=\underbrace{\underbrace{\tau^{+}(x)-\tau^{-}(x)}_{\text{Net Transfers}}+\underbrace{Y^{A}(x)-S(x)}_{\text{Asset-based Reallocations}}}_{\text{Age Reallocations}}$$

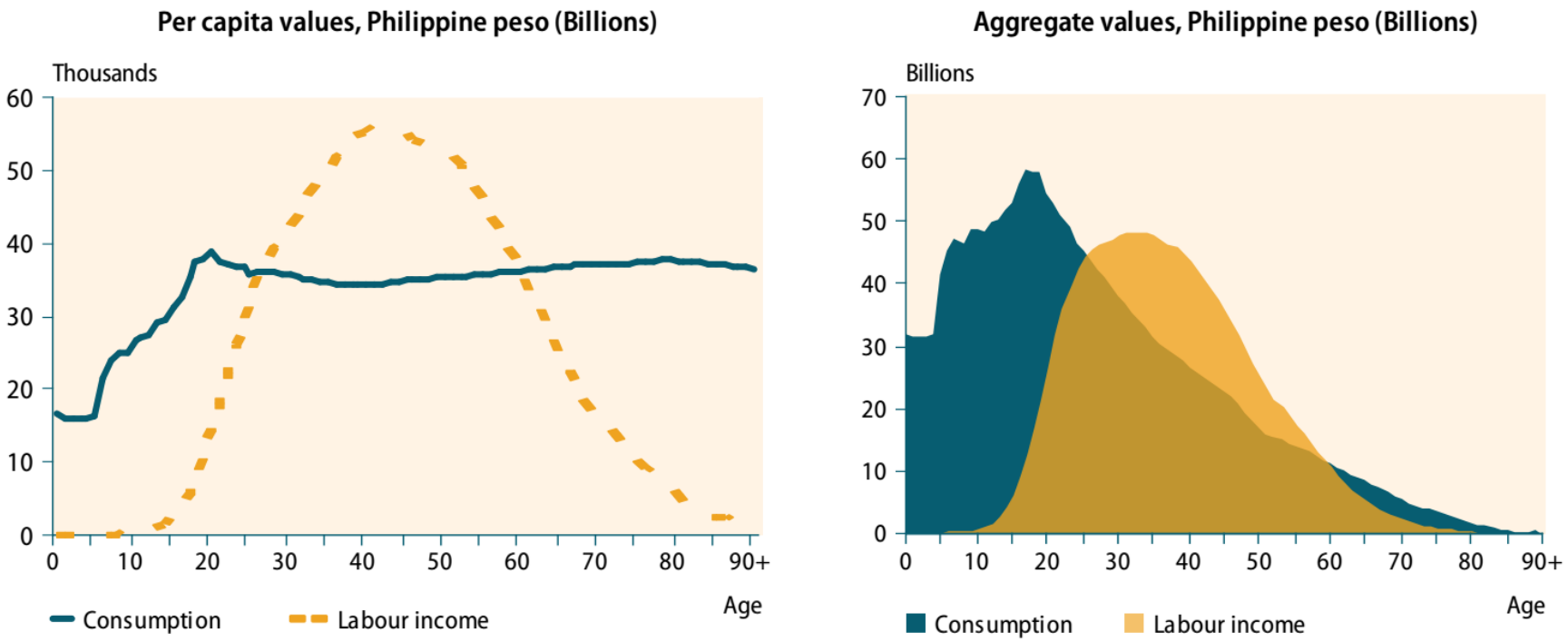
This session focuses on estimating the economic lifecycle account *age profiles*.

For calculating macro-controls for consumption and labor income, see Chapter 4 of NTA Manual.

Goal: Estimate lifecycle account

Figure 2.2.

Consumption and labour income by age, the Philippines, 1999



Note: Per capita values (left) in thousands of pesos. Aggregate values (right) in billions of pesos.

Outline

1. Building the micro-level database
2. Finalizing age profiles
3. Other topics

1. Building the micro database

1.1. Selecting and preparing the survey data

1.2. Creating individual-level variables

1.2.1. Labor income

1.2.2. Private consumption

1.2.3. Public consumption

Survey data

- Ideal: All variables are at individual level
- Common:
  - Matched Income-Expenditure and Labor Force Surveys
  - Individual-level earnings/wage rate
  - Household-level entrepreneurial income
  - Household-level consumption by type
- Additional variables
  - Age (Single-year)
  - Utilization indicator/rate
  - Other variables for disaggregation (sex, SES, etc.)

General rule

- Not much else to do if already individual-level
- Otherwise, need to allocate household-level variable to individuals

Labor income (YL)

- Standard types reported
  - Earnings (YLE)
  - Self-employment Income (YLS)
- Depending on context, may add other classes
  - Philippines: YLE by local and by overseas workers
  - Taiwan: YLE of current workers + deferred wages
  - Early versions: Benefits separate from earnings

Allocating YL (1)

- Earnings (YLE)
  - Wage rate, hours worked usually individual-level
  - Age profiles of benefits may be calculated separately, but usually assumed proportional to age profile of wages

Allocating YL (2)

- Self-employment income (YLE)
  - Usually at household level
  - Allocate to persons reporting to be self-employed
  - Use average wage by age of employed as weights

$$w_{i(a)j} = \begin{cases} \dfrac{\overline{w}_a^e}{\sum \overline{w}_{i(a)j} I(s)} & \text{self-employed} \\ 0 & \text{otherwise} \end{cases}$$

Figure 5.3.

Per Capital labour income by type of employment, Japan, 2004, and Mexico, 2004

Source: www.ntaccounts.org, accessed 23 July 2012.

Private consumption (CF)

- Standard types reported
  - Education (CFE) and health (CFH)
  - Other (CFX)
- Other important types
  - Owner-occupied housing, durables
  - Age-specific consumption goods: Alcoholic beverages, tobacco, etc.
- Often misunderstood expenditures
  - Insurance payment – not wholly consumption
  - Owner-occupied housing not purchase of houses

Allocating CF (1)

- Private education consumption (CFE)
  - Usually allocated using regression model

$$CFE_j = \sum_a \alpha(a) E_j(a) + \sum_a \beta(a) NE_j(a) + \varepsilon_j$$

    - CFE_j: Household education expenditure of household j
    - $E_j(a)$: Number of enrolled aged a in household j
    - $NE_j(a)$: Number of not enrolled aged a in household j
  - Allocate CFE_j using

$$\hat{x}_{ij} = \sum_a \tilde{\alpha}(a) D_{ij}[a, E] + \sum_a \tilde{\beta}(a) D_{ij}[a, NE]$$

$$CFE_{ij} = CFE_j \left(\hat{x}_{ij} \Big/ \sum_i \hat{x}_{ij} \right)$$

Allocating CF (2)

- Private health consumption (CFH)
  - Difficult to estimate age profile because of complexity of how private health consumption is financed: Out-of-pocket vs. private health insurance
  - Allocation to individuals depends on how health-care is financed, and the completeness of available data

Allocating CFH (2-1)

- Health expenditure survey
  - In some countries, available at individual level
  - May provide age profile of out-of-pocket spending but not necessarily of all private health consumption

Allocating CFH (2-2)

- Age profile of individual utilization rates
  - Similar to allocation of CFE_j
  - Requires availability of individual-level indicator for utilization, e.g. in-patient and out-patient care

$$CFH_j = \sum_a \alpha(a) IN_j(a) + \sum_a \beta(a) OUT_j(a) + \varepsilon_j$$

Allocating CFH (2-2a)

- Age profile of population utilization rates
  - May be used when individual-level indicator for utilization is *not available in same survey*

$$CFH_j = \sum_a \beta(a)U(a)M_j(a) + \varepsilon_j$$

  - $U(a)$: Utilization rate for age a
  - $M_j(a)$: Number of members aged a in household j
  - $\beta(a)$: Unit cost of each age
  - $\beta(a)U(a)$: allocation weight (numerator)

Allocating CFH (2-2b)

- Age profile of population utilization rates
  - Similar to previous model but assumed to follow a particular functional form of age

$$CFH_j = \sum_a \beta_0 U(a) M_j(a) + \sum_a \beta_1 a U(a) M_j(a) + \sum_a \beta_2 a^2 U(a) M_j(a) + \varepsilon_j$$

  - Allocation weight (numerator) calculated as

$$\hat{\beta}_0 U(a) + \hat{\beta}_1 a U(a) + \hat{\beta}_2 a^2 U(a)$$

Allocating CFH (2-3)

- Iterative method
  - Under certain conditions converges to estimates based on previous methods
  - Steps
    - Initialize: Allocate equally across household members
    - Calculate per capita average by age in population
    - Use per capita average by age as weights
    - Repeat last 2 steps until stable
  - Usually 2-3 iterations enough; robustness not fully established; guaranteed positive values

Allocating CFH (2-4)

- Simple regression approach
  - Not recommended unless nothing else is possible
  - Regress CFE_j on number of members by age

Allocating CF (3)

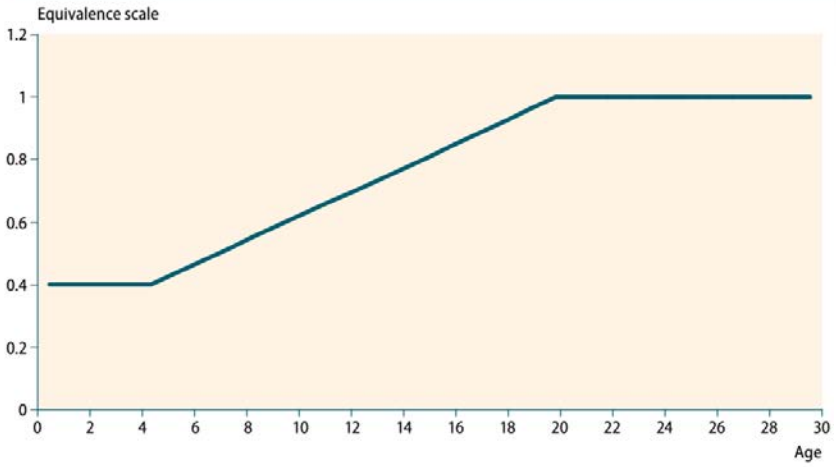
- Private other expenditure
  - For age-specific consumption, may use methods discussed to allocate CFH
  - For all others, use NTA age scale

$$\alpha(a) = 1 - 0.6 * D(4 < a < 20) * ((20 - a)/16 - 0.6 * D(a \leq 4)$$

  - Allocate CFX_i as

$$CFX_{ij}(x) = CFX_j \alpha(x) \Big/ \sum_a \alpha(a) M_j(a)$$

Figure 5.2.
Equivalence scale for allocating private consumption other than education and health



Public consumption (CG)

- Standard types reported
  - Education (CGE) and health (CGH)
  - Other (CGX)
- Other age profiles to calculate
  - Utilization of public education and public health facilities by type/level
  - Health spending paid by public/social health insurance system

Allocating CG (1)

- Public education consumption (CGE)
  - Allocated using unit cost per student for each schooling level and enrollment rate or utilization by level and age
  - Needs separate profiles by level; assumes unit cost do not vary by age within level; untargeted programs are allocated equally across population
  - Exclude cash transfer to parents for education as well as private spending in public schools, e.g., books, school uniforms, etc. paid by household

Allocating CGE (1-1)

- Calculate unit cost by level

Table 5.4.

Calculation of unit costs for education sector, illustrative values

	Primary	Secondary	Tertiary	Source
Public spending for public schools (billions)	50	100	75	Administrative records
Enrollment in public schools (millions)	25	40	10	Administrative records or household surveys
Unit cost (spending per student)	2,000	2,500	7,500	Calculated as spending divided by enrollment

Allocating CGE (1-2)

- Calculate age profile by level

Table 5.5.

Calculation of public consumption of primary school education, illustrative values

Age	Public primary school enrollment (millions)	Population (millions)	Public school enrollment rate	Consumption of public primary school per person
5	1.20	4.00	0.30	600
6	3.18	4.08	0.78	1,560
7	3.26	4.12	0.79	1,580
8	3.29	4.16	0.79	1,580
9	3.32	4.20	0.79	1,580
10	3.35	4.25	0.79	1,580
11	3.39	4.29	0.79	1,580
12	2.38	4.33	0.55	1,100
13	0.87	4.37	0.20	400
Total	**24.25**	**40**	--	--

Allocating CG (2)

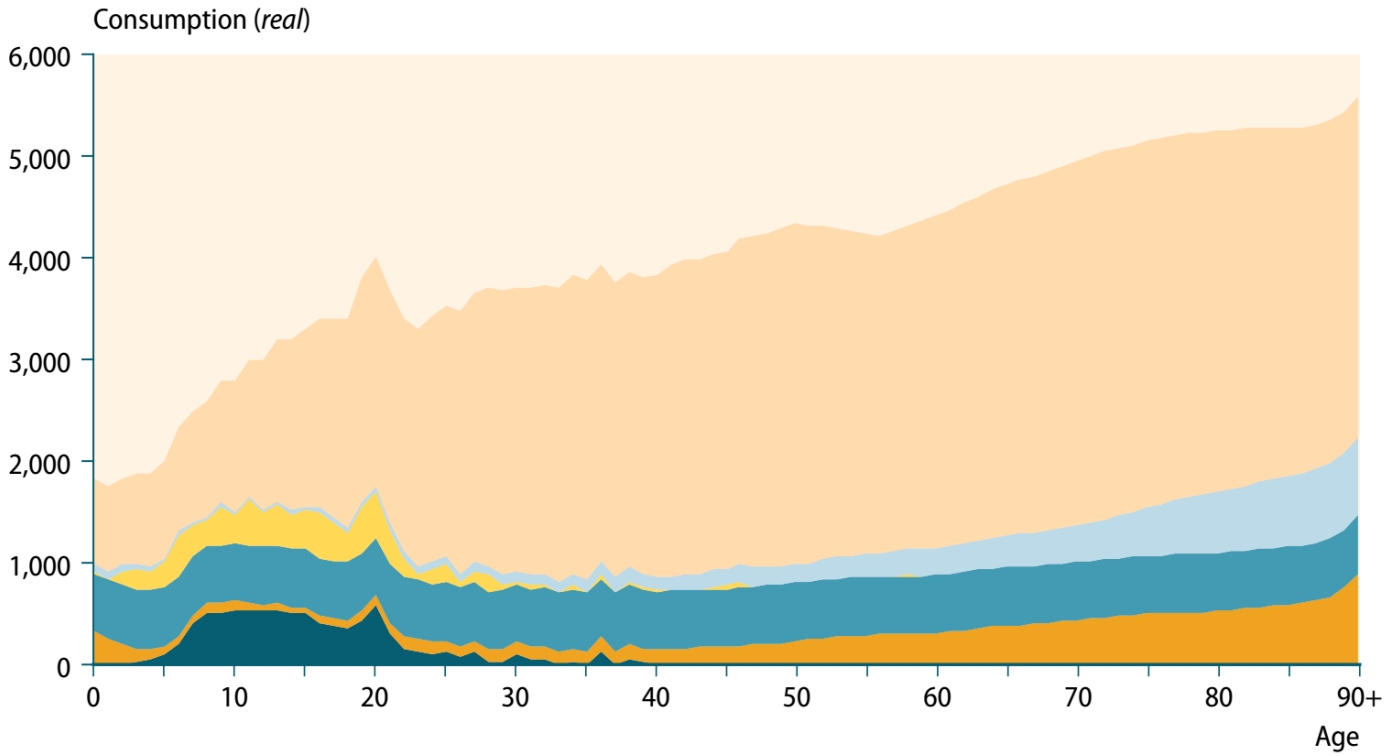
- Public health consumption (CGH)
  - Includes (i) health care reimbursed through public programs, (ii) healthcare provided directly by government facilities, (iii) collective services, e.g., health education and prevention programs
  - Health care spending associated with pregnancy is assigned to the mother
  - Allocation by age group
    - Assign (i) using similar methodology as in CFH
    - Assign (ii) using similar methodology as in CGE
    - Assign (iii) equally across population

Allocating CG (3)

- Other public consumption (CGX)
  - Includes (i) public collective consumption (national defense, roads, etc.), (ii) public individual consumption (day care, etc.) – other than education and health
  - Ideally, (ii) is assigned to those who receive the benefit by age; but in many instances (i) and (ii) are combined and allocated equally across the population

Figure 5.1.

Per capita consumption by sector, Brazil, 1996



Source: www.ntaccounts.org, accessed 23 July 2012.

2. Finalizing age profiles

2.1. Estimating per capita values

2.2. Smoothing per capita values

2.3. Adjusting to macro-controls (x)

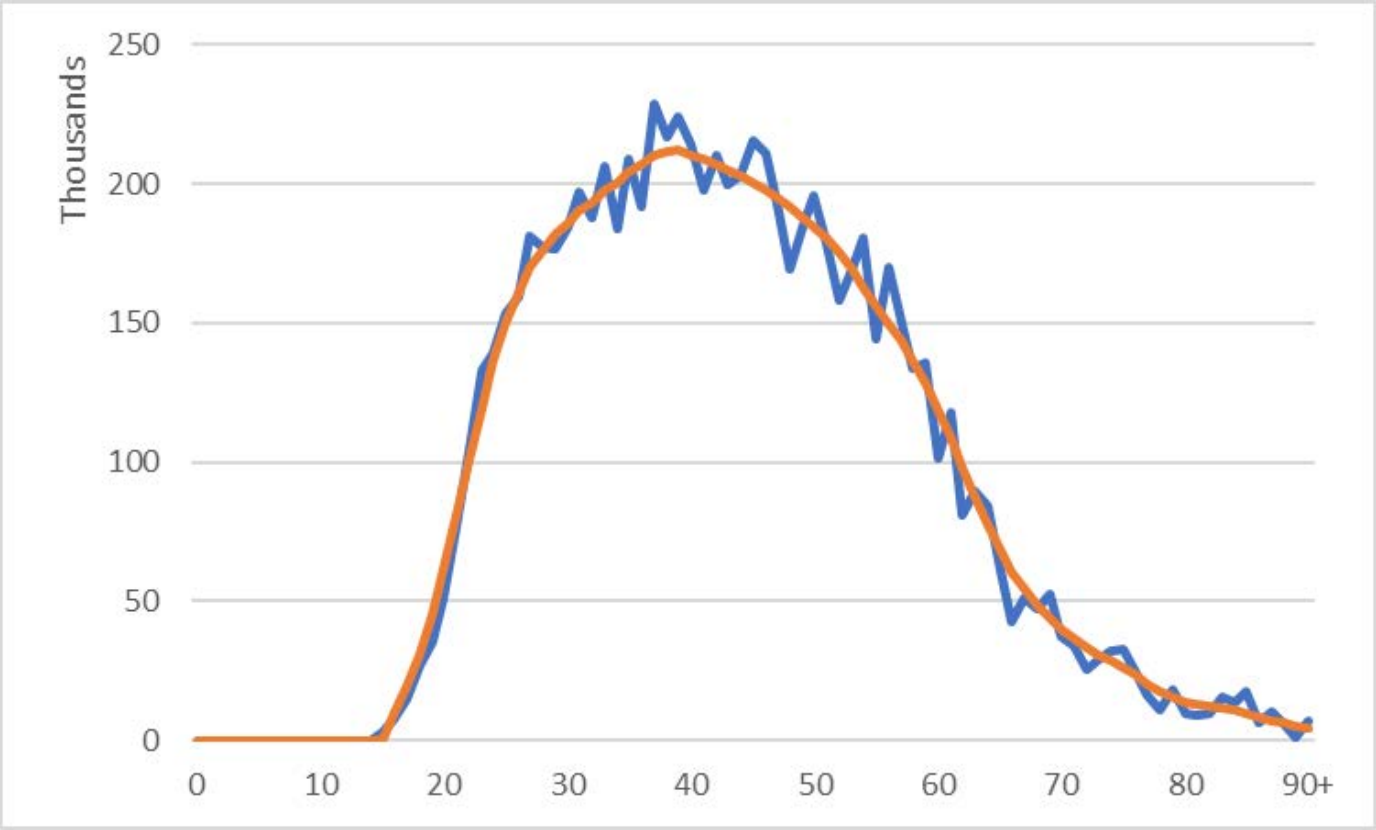
Estimating per capita profiles

- Once variables are available at individual level, per capita profile may be calculated by taking the average of each variable by age

Smoothing per capita profiles

- Needed to separate signal from noise
- Use unsmoothed per capita values
  - Education consumption at all ages
  - Health consumption at age 0
- Smooth sparingly to preserve features
  - Labor and consumption around retirement ages
  - Public health consumption around eligibility ages
- Smooth basic profiles, never higher-level variables
- Routine of choice: Friedman's (cross-validation) super smoother (supsmooth in Stata, supsmu in R)

- Philippines 2015: Labor Income



Adjusting to macro-controls

- Scale unsmoothed and smoothed age profiles such that the aggregate equals the macro-controls (for each type/sub-type)
- Scaling factor

$$\theta = \frac{X}{\sum_{a=0}^{w} x(a)\,N(a)}$$

- a: age a, single years ranging from 0 to ω
- $N(a)$: population count, age a
- X: macro control (i.e. national total, all ages combined)
- $x(a)$: per capita age pattern, age a
- $\bar{x}(a)$: per capita NTA age profile, age a
- $\bar{X}(a)$: aggregate NTA age profile, age a.

3. Other topics

3.1. Computing higher-level age profiles

3.2. Evaluation

3.3. Documentation

Discussion and Hands-on