New Methods and Sources of Estimating and Analyzing Student Attainment

Sherman Dorn, University of South Florida

Growth-corrected graduation rates

From Preston and Coale (1982), the probability of leaving a population from cause *i*:

$$\frac{l_i}{l_0} = \frac{\int_0^\infty D_i(a) e^{\int_0^a r(x)dx} da}{B}$$

where l_i/l_0 is the proportion of the equivalent synthetic population that would leave through cause *i* (usually cause-specific mortality), $D_i(a)$ is the instantaneous number of decrements (deaths) at age a through cause *i*, *B* is the number of births, and r(x) is the instantaneous proportional growth rate for the population.

Translating into a school population, starting at any age α or the time since enrollment:

$$\frac{l_g}{l_0} \cong \frac{\sum_j D_{gj} e^{\sum_{x=1}^{j-1} t_x(r_x - i_x) + \frac{1}{2} t_j (r_j - i_j)}}{B}$$

where D_{gj} is the total number of graduations in the *j*th interval, $(r_x - i_x)$ captures the average growth and in-migration rates in the *x*th interval, t_x is the width (in years) of the *x*th interval, and B is either the total number of birthdays at age α (or entering matriculants, as in higher education data).

Residual net flow

Consider a single age interval and its various decrements and additions in a period:

ΔN = Birthdays (x) – Birthdays (x+1) + Graduations
+ Net migration - Dropouts + Returnees – Deaths.

Grouping the last four terms together as an unadjusted net flow,

$$NF_i = \Delta N - B_i + AO_i + G_i$$

where NF_i is the unadjusted net flow, B_i is the number of students who age into the *i*th interval (or have matriculation anniversaries corresponding to the beginning of the interval), AO_i is the number of students who age out of the interval (or whose matriculation anniversaries push them out of the interval), and G_i is the number of students who graduate while in the interval. (An equivalent equation is for rates rather than numbers.)

NF_i is a residual net flow. The greater difficulty in identifying net dropping out for most student populations is distinguishing it from migration. My tentative strategy is to use average 7-10 net flow as the population baseline.

School life spent in grade(s) x

Combining the variable-rate expressions for life expectancy and the expected years of life spent in state G (with incidence g(a) at age *a*), one can estimate the expected proportion of school life spent in some state G starting at age α:

$$\frac{G'_\alpha}{e^0_\alpha} = \frac{\int_\alpha^\infty g(a)c(a) e^{\int_\alpha^a [r(x)-i(x)]dx} da}{\int_\alpha^\infty c(a) e^{\int_\alpha^a [r(x)-i(x)]dx} da}$$

where c(a) is the instantaneous distribution of the (student) population at age (a). As with growth-corrected graduation rates, one uses a discrete version for estimation purposes (not shown here). G'_α is useful when operationalized as time spent in a range of grades (for a whole student population) or in a specific year (where concerns are raised about retention in 9th grade).

Progress through grades ~ parity progression?

Progress from one grade to another is an ordinal sequence, but since skipping a grade is relatively rare, progress (or retention) can be treated akin to parity progression, and Schmertmann's (2002) suggestions for deriving period parity progressions from successive cross-sectional surveys is applicable:

$$gp(x,n;0,t) \cong \left(\frac{1}{2n} + \frac{1}{2t}\right)\left(GL(x+n,t) - GL(x,0)\right) + \left(\frac{1}{2n} - \frac{1}{2t}\right)\left(GL(x+n,0) - GL(x,t)\right)$$

where gp(x,n;0,t) is the grade progress for the age interval (x,x+n) between times 0 and *t* and GL(x,t) is the mean grade level of students aged *x* at time *t*. (Where the age interval and period are identical, the second term on the right drops out.) Critical assumption: GL(x,t) is not correlated with transitions in and out of student population. This estimate is only appropriate for ages below when students noticeably begin dropping out.

See side panels for specific examples, details, and references. Research support from the University of South Florida College of Education. Contact: dorn@mail.usf.edu.