

Lecture 13: Contemporary Issues

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With improved data on demographic processes the need for certain types of mathematical models has diminished gradually. Population censuses, improved vital registration systems, new data sources as Sample Registration Scheme in India, demographic health surveys, national surveys such as National Family Health Surveys in India (NFHS), child and reproductive health survey have provided quite reliable estimates of various demographic measures along with social class and urban-rural differences. Moreover, demographic transition from high to low death and birth rates is occurring in all countries of the world. Now the issues are no more estimation and prediction of demographic rates and ratios. There are other issues: aging and health at the older ages (Crimmins, 2005; Turra, et al., 2005; Lutz and Scherbov, 2005; Bongaarts, 2006; Jansen and Kunst, 2007), timing of the end of world population growth (Lutz et al., 2003, sexuality (Mensch, 2006, Gabrielli, 2007), determinants of neonatal mortality (Vandresse, 2008), and trends in HIV/AIDS (Bongaarts, 2008).

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Models have, however, provided insights into causes of change in the demographic variables. For example, using the simple multivariate regression analysis with total fertility rate as dependent variable and GDP per capita, life expectancy and gross primary and secondary school enrolment rate percent urban, and agriculture as percent of GDP as independent variables, Bryant drew the following conclusions:

- a. Fertility declines in countries with low scores on development indicators cannot be explained by socioeconomic theories
- b. The relationship between development indicators and fertility is weaker than predicted by socioeconomic theories
- c. The relationship between development indicators and fertility has shifted over time

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Bongaarts (2006) projected that in the future “longevity improvements will be larger and population aging will be more rapid than many governments of high income countries expect.” To demonstrate this point he decomposed life expectancy (LE). As defined by him, the conventional life expectancy at any time equals senescent life expectancy (LE_s) minus the longevity-reducing effects of background and juvenile mortality.

$$LE = LE_s - B - J$$

where

$$B = LE_s - LE_j$$

$$J = LE_j - LE$$

Thus

$$\Delta LE = \Delta LE_s + \Delta B + \Delta J$$

LE_j is the life expectancy without juvenile mortality. It equals the average age of death for a newborn if there is no chance of dying before 25 years. In other words it is LE at age 25 plus 25. LE_s is the life expectancy if some causes of death, such as cardiovascular disease and cancer, risk of which increases with age, are removed. Background mortality, by causes such as accidents, violence, and some infectious diseases, is independent of age. Bongaarts studied changes in LE, LE_j , LE_s , B and J for 16 high income countries with records from 1850 to 2000, separately for males and females. The background mortality was estimated from the observed data on force of mortality using the model

$$\mu(a) = \frac{\alpha e^{\beta a}}{1 + \alpha e^{\beta a}} + \gamma$$

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In the above equation β measures the rate of increase in mortality with age (a) and γ measures the background mortality. Thus the estimate of senescent mortality by age

$$\mu_a(a, t) = \mu(a, t) - \gamma(a, t)$$

for ages above 25.

$$LE_s(t) = 25 + \int_{25}^{\infty} e^{-\int_{25}^x (\mu(a, t) - \gamma(a, t)) da} dx$$

To consider the effect of specific factors such as prevention of smoking

$$\mu_{NS}(a, t) = (1 - s(a, t))\mu_s(a, t)$$

Decomposition of LE, therefore, provides an opportunity for making more informed projections of life expectancy for the future.

In the recent past, models based on advanced statistical techniques have become more popular than mathematical models ((Jansen, 2007; Vandersse, 2008)). Poisson regression (expressing log of rates as linear combination of independent variables), logit regression (expressing log odds as linear combination of independent variables) and multiple classification analysis are increasingly used by the social scientists. Guo and Harris (2000) used a structural equation model to examine effect of poverty and other factors on children's intellectual development.