6.8 The demographic formula used in this chapter

The formula for the calculations behind the tables and graphs in this chapter and in Appendix C was developed by Shahin Davoudpour, who also co-authored this section. For ease of exposition we did not go into the formula earlier, but for those who are interested, here it is:

$$P_t = P_{t-1} + \Sigma_{g=1}^{n}(\Phi_g P_g \beta_g)t - \Sigma_{g=1}^{n}(\Theta_g)t$$

We want to know what happens to a given population over a span of time ending at time t. P_t is the total population at time t. P_{t-1} is the initial population at an earlier time. Φ_g is the gender ratio of a particular generation g (for simplicity we set the ratio at 50/50 in all our calculations). β_g is the number of children allowed per woman in generation g at time t. θ_g is the number of deaths for generation g at time t. Finally, we must calculate for all generations during the span of time we considering. Hence, Σ indicates that the sum of the multiplication of the three variables in the parentheses for each generation of women having children at that time, which are between 1 and n (1,n), must be added to the sum for every other generation of women having children at that time. (In other words, more than one generation of women may be having babies at that time; we must run the numbers for all generations having babies at that time and add them up.)

Suppose, for example, that we want to know how much an initial population of one billion will grow by the birth of the third generation, fifty years after that one billion begins using life extension, where people have an average life expectancy of 150 years, the gender ratio is 50/50, and women have an average of one child at age 25 and .5 children at age 50. P_0 (P_{t-1}, t is 1, hence P_0) is the initial population. Variable g is 1 since it is the first generation, Φ_1 is .5 (the percentage of women in that population of 1 billion [P_1] is 50%), and β_1 is 1 child per woman for the generation of women who have their first child in that year (in other words, those who just turned 25 years of age). We get a total of 500 million children. Now the population of the world is 1.5 billion.

Twenty-five years later, the women in g_1 turn 50; they are now entitled to have an additional .5 children each. We run the numbers again (except that this time β_1 is .5 children per woman) and get another 250 million children. At the same time, 500 million people turn 25 (g_2), and the women