Innovation & Information Consultants, Inc.
ECONOMIC RESEARCH, ANALYSIS & CONSULTING

Projecting School-Age Enrollment: Use of the Cohort Survival Technique

PETER K. ASHTON & MARY ANN BUESCHER

Introduction

Rapid growth in school age populations as a result of the maturation of the baby-boomer generation has had far-reaching effects on school budgets, curriculum decisions, space issues, and school construction plans. In Massachusetts, school age enrollment has increased markedly in many communities in the last decade, prompting a flurry of new school construction proposals as well as decisions relating to services for children with special needs and children who are learning English as a second language. School administrators and policy makers require accurate and reliable estimates of future school populations in order to make informed decisions on such issues and to plan properly for the future. Our methodology and the projections we have developed for various school districts have served as the basis for several successful new construction projects as well budgeting decisions regarding influx of various types of special needs students. In this paper we present a model that provides reliable enrollment projections and points to the critical factors that drive changes in enrollment.

Determinants of School-Age Enrollment

A number of different factors contribute to changes in enrollment for grades kindergarten through 12. Such factors include the following:

- Trends in population
- Birth rates
- Migration in and out of a city or town
- Average household size
- School retention rate
- New housing construction
- School policies
- General economic conditions

Population trends have a direct and immediate impact on school enrollment. Some communities have witnessed population increases of 20-30 percent during the 1990s, and in those communities one naturally expects that enrollment will be on the rise. Communities in the western and southwestern suburbs of Boston have witnessed such rapid rates of population growth. Given this large

influx of people, the number of school age children has clearly increased. Birth rates also dictate school-age enrollment. Birth rates are driven in large part by the age distribution of females living in a particular community as well as the average age at which women decide to have children. A critical element in projecting elementary enrollment beyond a 5-year time horizon is estimating accurately future birth rates.

Migration of families in or out of town can also have a distinct impact on future enrollment. To the extent that a city or town becomes increasingly attractive (due to low property values or taxes, high quality schools, or other desired services), in-migration will increase enrollment and vice-versa. Also certain towns go through periods of increased housing turnover driven by "empty-nesters" moving out and new families with school-age children moving in that also impacts enrollment. Average household size is another important variable. Generally household size has remained fairly constant in recent years, but in some communities, the average family size has actually increased, thereby implying increased enrollment. The rate at which children remain in a given school as opposed to going to private school, known as the school retention rate, can also influence enrollment. The creation of charter schools in some districts as well as the attractiveness of certain private schools has led to changes in school retention rates in some districts. Finally, new housing construction, general economic conditions, and the establishment of various school policies, e.g., class size, can all have an impact on enrollment. Many, however, overemphasize the role of new housing construction on enrollment without understanding the importance of in-migration and housing turnover as drivers of enrollment increases.

Methods for Projecting Enrollment: The Cohort-Survival Method

Various methods might be employed to forecast enrollment changes. If one thinks of future enrollment as a function of past trends, one could use historical trends as a place to start. Such trends could be extrapolated to predict future enrollment. Statistical analysis also could be employed to estimate future enrollment based on changes in certain critical variables. However, although these and other techniques have been used to predict demographic trends including future enrollment, the method most widely employed and accepted for predicting future school enrollment is the "cohort-survival" method. This method is considered the most reliable. It captures the key determinants of enrollment, yet also allows for changes in historical trends, is relatively simple to apply and the data requirements are reasonable and usually easily fulfilled.

The major assumption underlying the cohort survival method is that the past to a large extent is a reasonable predictor of the future: that is, given the number of births, the net effect of all other factors (migration, policies, retention rates, new home construction, etc.) remain in relative balance.

The cohort-survival method requires the calculation of the ratio of the number of children in one grade in one year compared to the number of children who "survive" the year and enroll in the next

grade the following year. Fluctuations in such data from year to year create a pattern over time from which an average rate may be calculated to project enrollment. For example, if over a period of years, an average of 95 percent of the enrollment in grade 2 goes on to grade 3, and if 100 children are now enrolled in grade 2, the method (without any modifications) will predict that there will be 96 children in grade 3 next year. Clearly an important aspect of this computation is deciding the appropriate time period over which to compute the average grade-to-grade ratio. In cities and towns with rapidly changing demographic trends, shorter time frames are usually better, whereas in communities with more stagnant trends, longer time periods are preferred.

Forecasts for successive years must take as their starting points an estimate of the number of children entering kindergarten. These estimates are made by methods similar to those described above. An average birth to kindergarten survival rate is obtained by comparing known kindergarten enrollments to the number of births five years earlier. One computes this "birth to kindergarten" ratio over some relevant period of time and then applies this ratio to the number of births five years previously to derive a kindergarten enrollment projection for the current year. For example, if the average birth to kindergarten ratio was found to be 120 percent, a reasonable estimate for kindergarten enrollment would be the number of births (say 50) times 120 percent (60).

The cohort survival method is a function of two key variables, (1) the number of births, and (2) the calculated survival rates. As noted above, projections of elementary enrollment are limited to five years at most with actual birth data. Beyond five years, the number of births must be estimated, which leads to greater potential for error. Various techniques do exist for projecting birth rates and can be applied to generate elementary grade enrollment projections further into the future, but these must be viewed with a reduced level of confidence.

Figure 1 shows the cohort-survival method, including the birth projection component of the model. Births are to be a function of the number of women in a community of childbearing age and the number of births. Births are projected based on age-specific rates of birth and the number of females projected to be entering peak childbearing years. In- and out-migration of this element of the population must also be examined to accurately forecast births. Comparison of forecasted birth rates with actual birth rates have suggested that our model is relatively accurate in predicting birth rates.[1]

By its very nature, the cohort-survival method captures the effects of changes in population, migration, new housing construction, and the other determinants of enrollment. The method relies on historical data to establish proper ratios, but evaluation of other data, such as data on new housing permits, changes in population and household size may be used to determine whether the ratios should be adjusted, or whether a longer or shorter historical time horizon is more appropriate. For example, in one community for which we developed enrollment data, new housing starts

accelerated over a five-year period, then declined to historical levels. The ratios, particularly the birth to kindergarten ratio increased markedly in response to the increase in new housing construction, and then dropped off again. Unless one expected another peak of new construction similar to the one witnessed earlier, it would be erroneous to give too much weight to those years in computing the average ratios.[2]

Reliability of the Cohort-Survival Method

The reliability of the cohort-survival method is related to both the number of years one is projecting as well as the relative volatility of the historical data. Projections covering five years or less, especially at the elementary level, tend to be more reliable than projections going out more than five years. In addition, in some communities the numbers of births, population, household size, and net migration rates have held relatively steady which increases the reliability of the results. In other communities, one or more such variables exhibit extreme variation leading to less reliable results.

Validation tests may be performed on the enrollment forecasts by reviewing in subsequent years the relative accuracy of the projections, as well as by analyzing the factors that may have contributed to the variation from the forecast. We have regularly performed validation tests for one community and have found that the error rate in the enrollment forecasts across all grades has never exceeded 5 percent, although within certain grades it may be as high as 10 percent. This higher error rate almost always occurs at kindergarten or 1st grade and is due to two factors. First, there are a greater number of years between observed data points in computing the birth to kindergarten ratios than the grade-to-grade ratios and thus more chance for error (e.g., shifts on migration patterns). Second, parents have some discretion in making the choice of when to first send their children to a school district and this can affect the ratios as well as shift over time.[3] For example, some parents may prefer to hold their children back a year, or even send their children to private kindergarten.

Nevertheless, the cohort-survival technique with the modifications we have added to account for community specific factors has proven to be a reliable method for projecting school enrollment populations. Figure 2 shown below demonstrates this by comparing actual enrollment for one community compared with projections we developed several years ago.

Other Applications

This model may also be applied to specific circumstances to estimate enrollment for certain sub-groups or programs of a school population. For example, enrollment projections may be developed for children with special needs and children who are learning English as a second language. We apply the same Cohort-Survival method, but rather than treat an entire grade as a single cohort, we divide a grade into separate programs and develop program specific estimates of future enrollment based on historical data, grade progression ratios, and other relevant information. In one community that was undergoing substantial ethnic changes, we projected the rate of increase of bilingual

population based not only on historical data, but also demographic trends in that community and surrounding communities.

Endnotes

1 For three towns that we examined over the last five years, we were within 10 percent of accurately predicting births in each year.

2 There are two ways to handle this problem. One is to ignore those years completely in calculating the average, or second, one might select a relatively long time period over which to compute the average, thus diluting the impact of the "peak" years.

3 Obviously, changing the enrollment cutoff date for kindergarten can also have a significant effect and must be accounted for in evaluating birth to kindergarten ratios.