Projecting Enrollment in Rural Schools:
A Study of Three Vermont School Districts

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Large numbers of rural districts have experienced sharp declines in enrollment, unlike their suburban counterparts. Accurate enrollment projections are required, whether a district needs to build new schools or consolidate existing ones. For school districts having more than 600 students, a quantitative method such as the Cohort-Survival Ratio (C-SR) can be employed with a high level of confidence. For districts having fewer than 600 students, enrollment projections using quantitative methods may have diminishing accuracy. In the present study, enrollment projections were performed for three rural school districts in Vermont with populations fewer than 600 students. The objectives were to determine if (a) the C-SR method can be a viable alternative for school planners, (b) a lower enrollment threshold for employing quantitative techniques can be established, and (c) the number of years used to develop the survival ratio affects the accuracy of the projections. To test the accuracy of the C-SR method, enrollments were calculated for school years 1997-1998 to 2001-2002 and were compared to actual enrollments. Percent error rates were calculated for each school district for the prediction time period. The results showed that the C-SR method can be used cautiously to project enrollments for rural districts in the short-term, 1 to 3 years into the future, but loses its effectiveness in long-range planning. In addition, the results showed that the C-SR method could be used reliably for districts with as few as 100 students, which is a significantly lower threshold than reported in the literature.

While school districts in suburban settings such as New Jersey and Massachusetts are encountering rising enrollment and overflowing school buildings, many school districts in rural sections of the country are experiencing problems of a different kind, declining enrollments. From 1996-2000, 36.9% of rural public elementary and secondary schools had declines of at least 10% in their enrollments (Beeson & Strange, 2003). In an effort to plan for future enrollment trends, school districts rely on accurate enrollment projections using methods such as the Cohort-Survival Ratio, the Modified Regression Technique, and the Dwelling Unit Multiplier Technique. However, for districts of fewer than 600 students, the aforementioned enrollment projection techniques tend to produce less reliable results than they do for larger districts (Caffarella, 1983). While not all districts with fewer than 600 students are prone to less reliable projections, there is a greater probability that these districts will have more inaccurate projections than larger school districts.

Beeson and Strange (2003) defined "rural" as a community which consists of fewer than 2,500 people. In the same study, the state of Vermont was identified as having the largest percentage of rural population in the United States (61.8%) and for having the largest percentage of public school students enrolled in rural schools (56.1%). Vermont is ranked 16th nationally for having declining enrollment of at least 10% in its rural schools (43.1% of the rural schools in the state) between 1996-2000. Although many Vermont school districts are small due to its rural nature, important decisions still need to be made regarding facility planning, staffing, grade configurations, curriculum programs, and revenues (Dekel, 1994; Glass & Fulmer, 1991; Weldon, Hurwitz, & Menacker, 1989).

The most popular method for performing enrollment projections is the Cohort-Survival Ratio method. This method assumes that the rate of progression from one grade to the next (and also the ratio of the number of births to the number of kindergarten students 5 years later) will be consistent with rates of progression in previous years. The main assumption of this technique is that past enrollment patterns will continue into the future (Caffarella, 1983). The Cohort-Survival Ratio method is preferred due to its ease of use and small amount of historical data needed (3-5 years) to calculate future enrollment. Although research by Webster (1970) and Grip and Young (1999) suggested regression techniques provide better estimates than the Cohort-Survival

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Ratio method, the complexity of using multiple regression tools limits its usage by school district administrators.

To compute a survival ratio, the enrollment (e) in grade g in year y is divided by the enrollment in grade g-1 in year y-1 as shown below:

$$\text{Survival Ratio (from } g\text{-}1 \text{ to } g) = \left(\frac{e_{g,y}}{e_{g\text{-}1,y\text{-}1}} \right)$$

For example, if a district has 100 students in the third grade in 2000 and 108 students in the fourth grade in 2001, the survival ratio would be 1.08. Ratios greater than 1.00 indicate increasing enrollments while ratios less than 1.00 indicate declining enrollments. Rather than computing survival ratios to project future enrollment based on the data progression solely of 1 year, demographers often compute survival ratios based on an average of the past two, three, or four survival ratios. If a school district has seen an influx of new children as a result of homes constructed 3 or 4 years prior to performing the projections and expects similar growth from additional construction for the next 5 years of the projection period, a demographer may choose to use a 2- or 3-year average survival ratio to best capture the rate of growth. However, if a district's long-term historical enrollment growth is similar to what may be expected in the future, a 4- or 5-year average survival ratio can be utilized. The 4- or 5-year average survival ratio has the added advantage of smoothing out extreme survival ratios that may be considered an anomaly.

For districts with fewer than 600 students, the survival ratio can vary extensively with the slightest movement of students into or out of a school district. For example, consider two K-8 districts of 360 and 900 students, respectively. If the students are spread evenly among the nine grades, there would be 40 and 100 students in each grade, respectively. If five students enter each grade in each school district, the resulting enrollment would be 45 students and 105 students in each grade, respectively. In the first district, the computed survival ratio would be 1.12 while in the second district the computed survival ratio would be 1.05. In the district with smaller grade sizes, small movements of students either into or out of the district has the tendency to alter the value of the survival ratio more than in school districts with larger grade sizes. This increased variability in the computed survival ratios for districts with smaller grade sizes can result in less reliable results when projecting enrollments.

Methodology

In this study, enrollment projections for three Vermont school districts of fewer than 600 students were analyzed to determine if (a) an empirical enrollment projection technique (the Cohort-Survival Ratio method) could be effectively utilized; (b) a lower enrollment threshold could be established whereby some districts with enrollments fewer than 600 students could use a quantitative method to accurately project enrollment; and (c) the number of years utilized to compute an average survival ratio effects the accuracy of the projections based on the size of the district.

The three school districts selected in this study varied in both enrollment and the number of grade levels. Two districts consisted of grades K-12 while the third district consisted of grades K-8. The enrollment projections, which were computed for the school years 1997-1998 through 2001-2002, were based on historical enrollment data collected from 1991-1992 through 1996-1997. Actual enrollments collected from 1997-1998 through 2001-2002 were compared to projected enrollments to judge the Cohort-Survival Ratio method's effectiveness. Percent errors were only computed for each district's total enrollment and not by grade level. The formula for percent error is:

$$\text{Percent Error} = \left(\frac{\text{Projected Enrollment - Actual Enrollment}}{\text{Actual Enrollment}} \right) \times 100$$

According to Schellenberg and Stephens (1987), two thirds of surveyed school administrators target an overall error rate of 1% or less when projecting enrollment 1 year into the future. An acceptable error rate projecting 4-5 years into the future was 4-5%. Shaw, Alspaugh, and Wat-Aksorn (1997) investigated 20 school districts to determine the accuracy of the Cohort-Survival Ratio, Percentage Survival, and Law of Growth methods. The Cohort Survival-Ratio method, which performed the best of the three methods, had a mean error rate of 1.55% for projecting 1 year into the future and a mean error rate of 4.73% for projecting enrollment 5 years

Table 1
Total Enrollment by School District and Year

Year	District A (Grades K-8)	District B (Grades K-12)	District C (Grades K-12)
1991–1992	101	255	454
1992–1993	96	242	468
1993–1994	111	247	458
1994–1995	112	248	471
1995–1996	99	257	479
1996-1997	110	291	510
1997-1998	*107*	*284*	*530*
1998-1999	*104*	*265*	*514*
1999-2000	*99*	*266*	*492*
2000-2001	*92*	*228*	*398*
2001-2002	*89*	*222*	*413*

Note. Italicized data from 1997-1998 through the 2001-2002 school years were used for comparing the enrollment projections computed in the study.

Table 2
Projected Enrollment and Error Rates for District A

Year	Actual Enroll.	2-Year Cohort		3-Year Cohort		4-Year Cohort		5-Year Cohort	
		Projected Enroll.	Percent Error	Projected Enroll.	Percent Error	Projected Enroll.	Percent Error	Projected Enroll.	Percent Error
1997/1998	107	107	**0.00%**	106	-1.06%	110	2.45%	108	0.73%
1998/1999	104	105	**1.23%**	103	-1.19%	111	7.19%	109	4.42%
1999/2000	99	108	9.10%	106	**7.47%**	119	19.77%	115	15.98%
2000/2001	92	104	12.60%	101	**10.04%**	118	28.63%	113	23.30%
2001/2002	89	99	11.59%	97	**8.96%**	116	30.78%	111	24.40%

Note. Bolded values represent the lowest error rates of the survival ratios in a given projection year.
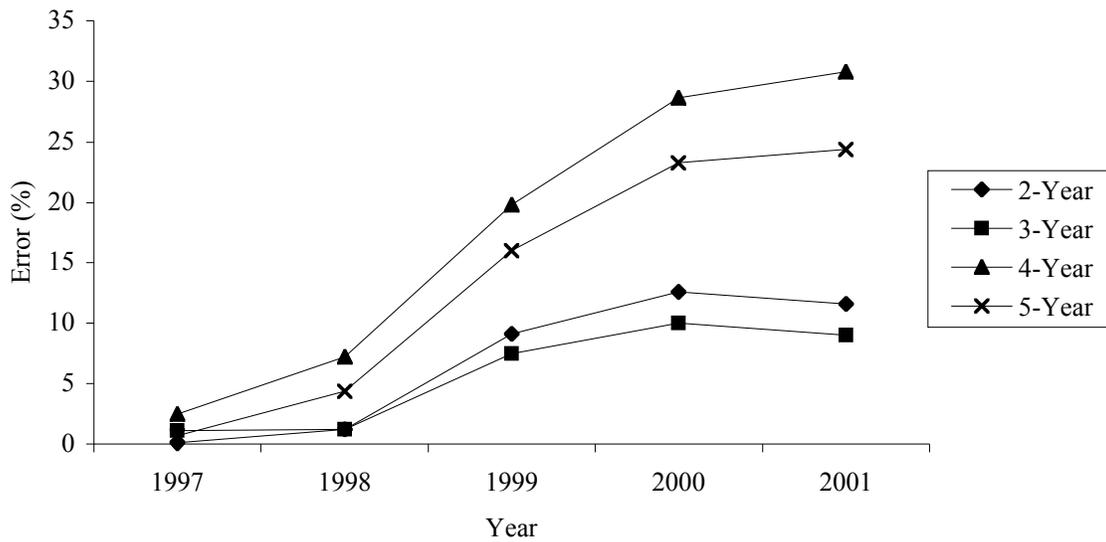

Figure 1. Percent error rates for the projected school years of 1997-1998 to 2001-2002 in District A based on 2-, 3-, 4-, and 5-year average survival ratios

into the future. In the intermediate years, mean error rates increased by slightly less than 1% per year.

Historical birth data were collected from the state of Vermont for the three sending communities for the years 1987-1996 to compute birth to kindergarten survival ratios from 1992-1996 and to project kindergarten enrollment for 1997-1998 through 2001-2002.

Table 1 shows historical total enrollment for each school district. While none of the districts experienced declining enrollment for the historical time frame, all districts had declining enrollment for 1997-1998 through 2001-2002. From 1991-1992 to 1996-1997, District A did not display any consistent trends of enrollment growth or decline. Enrollment vacillated between 96 and 110 pupils for the 6-year

time period. Enrollment in District B was relatively stable for the same time period before rising sharply in 1996-1997, the last year of the historical enrollment data. Finally, District C experienced rising enrollment except for the 1993-1994 school year when a small decline was recorded.

Each of the three district's enrollments was projected using a 2-, 3-, 4-, and 5-year average survival ratio. As discussed previously, since the ratio in smaller districts and subsequently smaller grade levels can be sharply affected by the inward or outward migration of just a few students, it was projected that the 5-year average would produce the most accurate results as any anomalies in the survival ratio would be minimized.

Table 3
Projected Enrollment and Error Rates for District B

Year	Actual Enroll.	2-Year Cohort		3-Year Cohort		4-Year Cohort		5-Year Cohort	
		Projected Enroll.	Percent Error	Projected Enroll.	Percent Error	Projected Enroll.	Percent Error	Projected Enroll.	Percent Error
1997/1998	284	287	**0.98%**	280	-1.58%	275	-3.34%	273	-4.03%
1998/1999	265	292	10.21%	279	5.20%	270	1.94%	266	**0.53%**
1999/2000	266	294	10.71%	273	2.56%	261	**-1.87%**	255	-3.99%
2000/2001	228	297	30.18%	268	17.55%	256	12.17%	249	**9.05%**
2001/2002	222	310	39.86%	271	22.06%	256	15.20%	247	**11.22%**

Note. Bolded values represent the lowest error rates of the survival ratios in a given projection year.
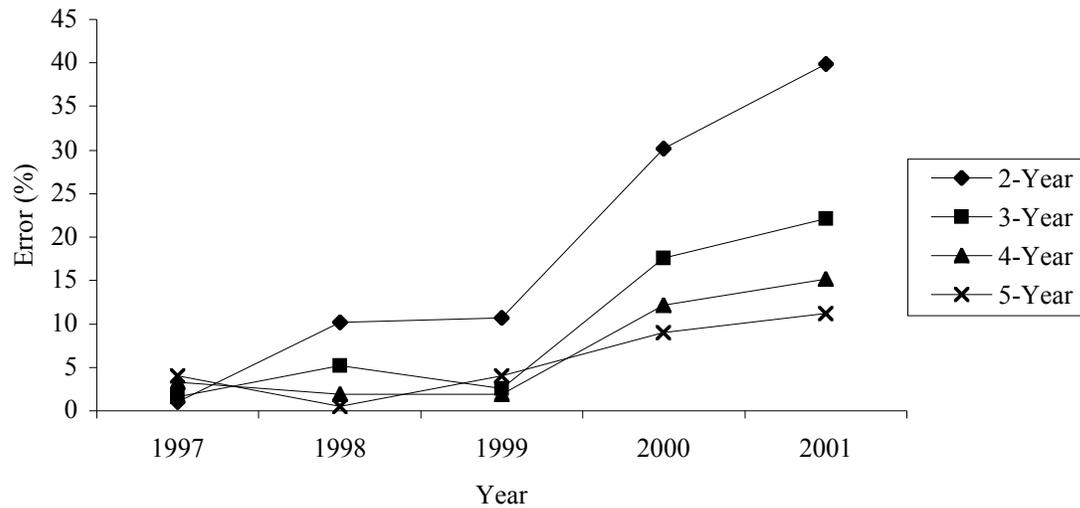

Figure 2. Percent error rates for the projected school years of 1997-1998 to 2001-2002 in District B based on 2-, 3-, 4-, and 5-year average survival ratios

Results

For District A, both the 2- and 3-year average survival ratios produced the most accurate projections (see Table 2). Actual enrollment for District A steadily declined over the 5-year period from 107 students in 1997-1998 to 89 students in 2001-2002. This contrasts with District A's historical enrollment from 1991-1992 to 1996-1997, which showed relatively no pattern.

In the first two years of the projection period, the 2-year average survival ratio resulted in error rates of 0.00% and 1.23%, which were the most accurate projections of the four calculations. For the remaining 3 years of the projection, the 3-year average survival ratio was most accurate with

error rates ranging from 7.47% to 10.04%. Each projection method overestimated the number of children in projection years 3 through 5. Of the four ratios, the 4-year average survival ratio generated the least accurate results. The error rates, which are displayed in Figure 1, show the relative accuracy of the four enrollment projections.

In District B, the most accurate projections were produced by the 5-year average survival ratio for 3 of the 5 projection years. Like District A, District B's enrollment declined from 284 students in 1997-1998 to 222 students in 2001-2002. The declining trend also contrasts the stable historical enrollment recorded from 1991-1992 to 1996-1997 (see Table 3). The 2-year average survival ratio produced the most accurate projection in the first projection year but

Table 4
Projected Enrollment and Error Rates for District C

Year	Actual Enroll.	2-Year Cohort		3-Year Cohort		4-Year Cohort		5-Year Cohort	
		Projected Enroll.	Percent Error	Projected Enroll.	Percent Error	Projected Enroll.	Percent Error	Projected Enroll.	Percent Error
1997/1998	530	479	**-9.56%**	471	-11.15%	464	-12.42%	464	-12.41%
1998/1999	514	480	**-6.59%**	464	-9.74%	451	-12.27%	452	-12.01%
1999/2000	492	461	**-6.30%**	440	-10.51%	424	-13.91%	427	-13.11%
2000/2001	398	454	14.02%	430	8.14%	412	**3.52%**	417	4.78%
2001/2002	413	443	7.17%	418	**1.29%**	397	-3.83%	405	-2.02%

Note. Bolded values represent the lowest error rates of the survival ratios in a given projection year.
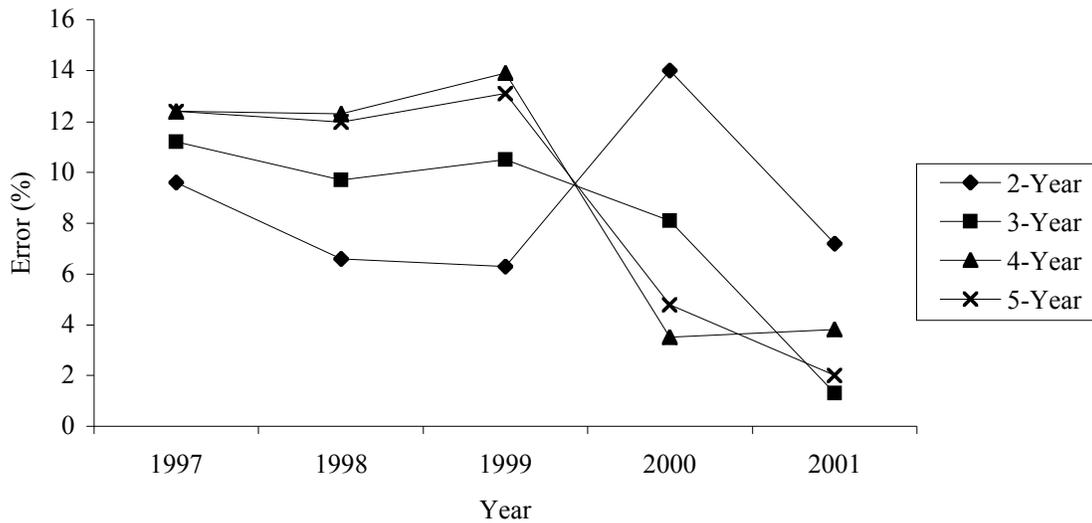

Figure 3. Percent error rates for the projected school years of 1997-1998 to 2001-2002 in District C based on 2-, 3-, 4-, and 5-year average survival ratios

then significantly overestimated enrollment for projection years 2 through 5. The 4- and 5-year average survival ratios produced the most accurate results for the remaining 4 projection years, yet each of these methods significantly overestimated enrollment in the final 2 years of the projection period. Error rates for each of the four enrollment projections are shown in Figure 2.

For District C, the 2-year average survival ratio produced the most accurate projections for 3 of the 5 projection years. Actual enrollment steadily declined from 530 in 1997-1998 to 398 in 2000-2001 before rebounding to 413 in 2001-2002. Prior to 1997-1998, District C had been experiencing increasing enrollment. Except for the projection by the 2-year average survival ratio, percent errors for the

remaining projections typically decreased over the 5-year period (see Figure 3).

Figures 1 and 2 for District A and District B both show low error rates in the first few projection years followed by larger error rates near the end of the projection period. Each of these districts experienced greater declining enrollments in the long-term than was anticipated by historical enrollment trends leading to larger error rates. In contrast, District C's percent errors were greatest in the first few projection years and declined over time (see Figure 3). The large error rates initially were caused by an unexpected growth in enrollment. District C grew much faster than originally projected. Percent errors declined over time because the drop

in enrollment that was projected was similar to the declining enrollment that actually occurred.

Discussion

The results of this study confirm the difficulty of projecting enrollment in school districts with fewer than 600 students. District C, the largest district, had the lowest error rates when projecting 4 or 5 years into the future. However, contrary to what was projected, the 2-year average survival ratio produced the most accurate projections for the first three projection years. None of the four enrollment projection methods had error rates less than 6% in the first three projection years.

In the short term, projecting one or 2 years into the future, the smaller district projections were more accurate than in the longer term. Error rates for District A and District B were less than 2% when projecting enrollment for the first two years which is consistent with the mean error rates reported by others (Schellenberg & Stephens, 1987; Shaw, Alspaugh, & Wat-Aksorn, 1997).

In the longer term, the projected enrollments of District A and District B were less accurate. District A and District B had differing results in the projection method that performed best. For District B, the 5-year average survival ratio produced the most accurate results for 3 of the 5 projection years. For District A, the 3-year average survival ratio provided the most accurate results in 3 of the 5 projection years. On average, the 4- and 5-year average survival ratios produced the most accurate results for District B while the 2- and 3-year average survival ratios produced the most accurate results for District A.

The results suggest that there is no conclusive evidence on the number of years that should be used to compute a survival ratio based on district size. Instead, the Cohort-Survival Ratio method can be used with caution for short-term (1-3 years) planning for districts having fewer than 600 students. District A, which had low error rates in the first two projection years, had an enrollment of approximately 100 students. This indicates that the Cohort-Survival Ratio method can be used for districts with fewer than 600 students. Since the effectiveness of the Cohort-Survival Ratio method was limited to short-term planning, school districts should update the enrollment projections yearly to reevaluate enrollment growth or decline to ensure the highest level of accuracy. Unfortunately, the Cohort-Survival Ratio method is unreliable for projecting enrollments in the long-term

for smaller school districts. District administrators in small schools cannot rely on projections using this method to make decisions about constructing new schools or consolidating existing ones.

While clearly the greatest limiting factor of this study was the small number of districts in each size category, future research could analyze a larger number of districts of similar size to determine if there are advantages to using a specific survival ratio (2-year average, 3-year average, etc.) based on district size. In addition, other quantitative enrollment projection techniques can be investigated to determine their accuracy compared to the Cohort-Survival Ratio method for small school districts.

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