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An Alternative K-12 Enrollment Forecast Method for Older Neighborhoods

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Many of our school district clients are concerned about enrollment increases in older neighborhoods consisting of SFUs (single family units, or houses). Usually these neighborhoods have stable, low enrollments, but sometimes there are enrollment increases. Can we predict which neighborhoods will experience enrollment increases, when they will experience them, and what the magnitude of the increases will be? Using the traditional cohort survival approach to forecast school enrollments typically misses enrollment increases, because migration trends (expressed through grade progressions and kindergarten/birth ratios) are usually assumed to continue. This paper presents an alternative to the cohort survival forecast method. Our alternative method is a modification of the Housing Unit Method (HUM) and focuses on houses' length of ownership. The distribution of homes by length of ownership is forecasted, and the number of homes in each category is multiplied by the appropriate student yield in order to forecast enrollments.

Older SFU neighborhoods (neighborhoods consisting of Single Family Units, or houses) typically have low and stable enrollments. However, occasionally, we find an older neighborhood that experiences a large enrollment increase.[2] The questions for school demographers are whether we can foresee which older neighborhoods will later show enrollment changes and, if so, what the magnitude of those changes would be. Some older neighborhoods have surplus school sites, both because enrollments used to be much higher and because schools were smaller in the past. School administrators must decide whether they should sell these sites or retain them in case enrollments rise in the future.

[1] I would like to acknowledge the substantial help of Jeanne Gobalet. I also would like to thank Peter Morrison for his helpful comments on earlier versions of this work.
[2] For example, in Palo Alto, California, enrollments from housing built in the 1950s gradually increased by 18 percent between 1993 and 2005.

To address the concern that housing turnover may cause enrollment increases, this chapter presents an alternative forecast method we developed specifically for older SFU neighborhoods. In our research we have found that student yields (the average number of students per housing unit) in houses vary tremendously by length of ownership – long held homes have few students while older homes bought in the last 10 or so years have substantial enrollments. Length of ownership could well be the most important predictor of a house's student yield. Fortunately, data are now available (from digitized county assessors records) to calculate length of ownership for each single-family housing unit.

The alternative forecast model predicts the distribution of the future length of ownership for homes in a district (or neighborhood). When there is an increase in the number of homes with 20+ years of ownership, then enrollment declines are likely. If, on the other hand, when there is a decrease in the number of homes with 20+ years of ownership, enrollments are likely to increase. For a more precise forecast, student yields by length of ownership can be applied to the future distributions of houses by their length of ownership.

The Model

The alternative forecast method is an innovative use of the Housing Unit Method (HUM). The basic form of the HUM is to multiply student yields by the number of houses in the district. The added wrinkle here is that we categorize houses by their length of ownership and calculate student yields by length of home ownership. The number of houses by length of ownership is multiplied by the student yield by length of ownership.

The first step is to forecast the future distribution of houses by their length of ownership. Then we multiply this distribution by student yields (by length of ownership). For those who like equations, the forecast is simply:

Enrollments (time t) =

Sum of (# Houses by length of ownership (time t)) * (Student Yields by length of ownership (time t))

Table 1 illustrates a hypothetical enrollment forecast for some future time. The future length of ownership is predicted, which is then multiplied by the anticipated student yield. The result is the number of students in homes at each length of ownership. The summation of which is the total enrollments in the future year from houses. In this example, a total of 16,030 houses produces 6,457 students, for a district-wide student yield of .40.

Note that these enrollment forecasts include only those students living in houses. Enrollments in apartments, townhouses, condominiums, etc., would need to be forecast separately.

Table 1

Illustration of Alternative Method

Yrs of Ownership	Predicted Number of SFUs at each Length of Ownership, "Time T+8"	Anticipated Student Yield (Usually the Historical Values)	Forecasted Enrollments from Houses, Time T+8
0	405	0.54	220
1	379	0.64	241
2	354	0.84	297
3	332	0.87	290
4	312	0.91	282
5	294	0.82	241
6	279	0.91	254
7	268	0.94	252
8	231	0.88	203
9	214	0.82	175
10	179	0.80	144
11	242	0.75	181
12	265	0.73	194
13	233	0.68	160
14	177	0.87	153
15	221	0.64	142
16	307	0.67	207
17	304	0.56	169
18	337	0.56	189
19	325	0.44	142
20	298	0.38	113
21	329	0.36	118
22	353	0.30	107
23	288	0.28	80
24	311	0.21	66
25	218	0.24	53
26	258	0.33	84
27	275	0.35	97
28	279	0.23	64
29	248	0.30	75
30	253	0.27	68
31	271	0.19	52
32+	6,993	0.19	1,344
Total	16,030		6,457

All in all, three inputs are needed for this alternative enrollment forecast:

1. The current length-of-ownership distribution for all the SFUs in the District (or in the area being forecasted);

2. Turnover rates by length of ownership; and
3. Student yields by length of ownership.

The first input – the current length of ownership distribution for all the SFUs – is a data item. One should be measuring the actual distribution. The following two inputs are assumptions, and are typically based on historical values.

The first two inputs are used to forecast the future length-of-ownership distribution.

The last input is used to produce a precise estimate of future enrollments.

Predicting the Future Length of Ownership Distribution for Housing

Using a cohort survival approach, it is possible to predict the future distribution of houses by how long they have been owned. We start with the current distribution of houses by how long they have been owned. (We obtain the length of ownership distribution from the "last sales date" in assessor's parcel data; see box on page x for a discussion of sales dates.)

To obtain next year's length-of-ownership distribution, we "age" each length of ownership by one year. For example, the group of homes with 10 years of ownership has 11 years of ownership next year, 12 years of ownership the year after, and so on. However, as in any cohort survival model, not all the houses will "survive" to the next length of ownership category. Some will be sold before reaching the 11 years of ownership category, and will then have zero years of ownership next year, while the rest will have 11 years of ownership. We apply housing turnover rates (defined and discussed in the next section) to predict the number of the 10-year homes that will "survive" to be 11-year homes.

In short, these are the steps we follow to forecast the future numbers of homes by length of ownership:

1. Categorize houses by their current length of ownership (using last sales date from parcel data), i.e., one year of ownership, two years of ownership, three years and so on.
2. Advance the houses to the next length of ownership, after applying housing turnover rates by length of ownership (defined and discussed in the next section).

3. Obtain the number of houses with zero years of ownership: these are the houses that changed ownership in the prior year. (One easy way to calculate this is to sum the projected homes with 1+ years of ownership. The difference between this figure and the total number of housing units is the number of homes with zero years of ownership.)
4. Repeat this process for as many years into the future as one thinks reasonable.

Table 2 illustrates the forecast procedure for predicting length of ownership. It shows the detailed calculations for forecasting the length of ownership distribution one year into the future. The actual distribution, which we'll call "Time T" is shown in Column C. These should be measured from actual data, as discussed later. Column B shows turnover rates, which are typically historical values measured from data and assumed to continue in the future. The number of homes at each length of ownership are multiplied by the turnover rate at that length of ownership to obtain the number of homes that will change ownership (Column D). For example, 7.0 percent of the 389 homes with less than one year of ownership are anticipated to change ownership again, for a total of 27 homes. Column E shows the "survivors," that is, the homes that do not change ownership and progress to the next length of ownership. The 389 homes that had less than one year of ownership become the 362 units with one year of ownership in the following year (Column E). The total number of turnovers (bottom row of Column D) become the houses with less than one year of ownership in the following year. In this example, the 409 turnovers become the number of homes with less than one year of ownership in T+1. Column F simply repeats Column E, and adds the number of homes with less than one year of ownership.

This process can be repeated for as many years into the future as one pleases. In this example, Column F becomes the new length of ownership distribution, to which turnover rates are applied to, and the process continues. Table 3 shows the resulting length of ownership distribution if we were to repeat this process for eight years. In this example, note that the number of long-held homes rises, suggesting that enrollments are likely to decline in this school district example.

Table 2

Forecasting Process for Length of Ownership of SFUs

(A)	(B)	(C)	(D)	(E)	(F)
			D=B*C	E=C-D of the prior length of ownership	F=E for 1+ Year of Ownership; F at 0 Yr of Ownership is the Sum of D
Yrs of Ownership	Turnover Rate	Actual Length of Ownership Distribution in Base Year (number of SFUs), "Time T"	Turnovers during Base Year	Homes not sold during Base Year and Have One More Year of Ownership	Forecasted Length of Ownership Distribution for the following year (Number of SFUs), "Time T+1"
0	7.0%	**389**	27		430
1	7.1%	**351**	25	362	362
2	6.8%	**284**	19	326	326
3	6.8%	**370**	25	265	265
4	6.7%	**391**	26	345	345
5	6.0%	**332**	20	365	365
6	5.2%	**244**	13	312	312
7	4.9%	**297**	15	231	231
8	4.3%	**402**	17	282	282
9	4.0%	**389**	15	385	385
10	3.5%	**422**	15	374	374
11	3.5%	**401**	14	407	407
12	3.2%	**363**	12	387	387
13	3.0%	**396**	12	351	351
14	2.6%	**420**	11	384	384
15	2.2%	**339**	8	409	409
16	2.1%	**364**	8	331	331
17	2.0%	**254**	5	356	356
18	2.1%	**300**	6	249	249
19	1.9%	**318**	6	294	294
20	2.1%	**321**	7	312	312
21	1.9%	**283**	5	314	314
22	1.8%	**287**	5	278	278
23	1.7%	**306**	5	282	282
24	1.7%	**180**	3	301	301
25	1.7%	**176**	3	177	177
26	1.6%	**235**	4	173	173
27	1.4%	**269**	4	231	231
28	1.4%	**322**	4	265	265
29	1.4%	**274**	4	318	318
30	1.4%	**211**	3	270	270
31	1.4%	**229**	84	208	208
32+		**5,911**		6,056	6,056
Total		**16,030**	430	15,600	16,030

Table 3

Forecast of Length of Ownership of SFUs

Yrs of Ownership	Turnover Rate	Actual Number of SFUs by Length of ownership, Time T	Number of SFUs, Time T+1	Number of SFUs, Time T+2	Number of SFUs, Time T+3	Number of SFUs, Time T+4	Number of SFUs, Time T+5	Number of SFUs, Time T+6	Number of SFUs, Time T+7	Number of SFUs, Time T+8
0	7.0%	**389**	430	424	420	416	413	410	407	405
1	7.1%	**351**	362	400	394	390	387	384	381	379
2	6.8%	**284**	326	336	371	366	363	359	357	354
3	6.8%	**370**	265	304	313	346	341	338	335	332
4	6.7%	**391**	345	247	283	292	322	318	315	312
5	6.0%	**332**	365	322	230	264	272	301	297	294
6	5.2%	**244**	312	343	303	216	248	256	283	279
7	4.9%	**297**	231	296	325	287	205	235	243	268
8	4.3%	**402**	282	220	281	309	273	195	224	231
9	4.0%	**389**	385	270	211	269	296	261	187	214
10	3.5%	**422**	374	369	260	202	259	284	251	179
11	3.5%	**401**	407	360	356	250	195	250	274	242
12	3.2%	**363**	387	393	348	344	242	188	241	265
13	3.0%	**396**	351	375	380	337	333	234	182	233
14	2.6%	**420**	384	341	363	369	327	323	227	177
15	2.2%	**339**	409	374	332	354	359	318	314	221
16	2.1%	**364**	331	400	365	324	346	351	311	307
17	2.0%	**254**	356	324	391	358	317	339	344	304
18	2.1%	**300**	249	349	318	383	351	311	332	337
19	1.9%	**318**	294	244	342	311	375	343	304	325
20	2.1%	**321**	312	288	239	335	305	368	336	298
21	1.9%	**283**	314	305	282	234	328	299	360	329
22	1.8%	**287**	278	308	300	276	229	322	293	353
23	1.7%	**306**	282	273	303	294	272	225	316	288
24	1.7%	**180**	301	277	268	298	289	267	222	311
25	1.7%	**176**	177	296	272	263	293	284	262	218
26	1.6%	**235**	173	174	291	268	259	288	279	258
27	1.4%	**269**	231	170	171	286	263	255	283	275
28	1.4%	**322**	265	228	168	169	282	260	251	279
29	1.4%	**274**	318	262	225	166	166	278	256	248
30	1.4%	**211**	270	313	258	222	163	164	274	253
31	1.4%	**229**	208	267	309	255	219	161	162	271
32+	1.4%	**5,911**	6,056	6,179	6,358	6,576	6,738	6,862	6,927	6,993
Total		**16,030**	16,030	16,030	16,030	16,030	16,030	16,030	16,030	16,030

Housing Turnover Rates

An historical housing turnover rate is calculated by taking a group of homes and measuring the percentage of those homes that change ownership during a one-year period. For example, if there are 100 homes with five years of ownership and 10 of those homes changed ownership during the year, the housing turnover rate for homes owned five years is 10 percent (10/100), or conversely, the survival rate is 90 percent.

Housing turnover rates by length of ownership are very important, critical in fact. They determine whether the neighborhood will have longer or shorter lengths of ownership. Most obviously, low housing turnover rates result in many long-held homes, and thus low enrollments. Conversely, high housing turnover rates result in fewer long-held homes, and thus high enrollments.

Less obvious is that the "shape" of the housing turnover rate schedule can affect the future length of ownership distribution. By shape we mean how the turnover rate varies by length of ownership. Figure 1 illustrates four theoretically possible "shapes" to the housing turnover schedule:

- Chart A assumes housing turnover does not vary by length of ownership: a house owned two years is as likely to change ownership as one held for 30 years.
- Chart B shows housing turnover rates that start out high but decline with length of ownership, holding steady for those units with 20 or more years of ownership. This is what we have found in our research, but we have no data for homes held longer than 30 years.
- Chart C shows a "U-shaped" housing turnover schedule that starts out high and declines with length of ownership, but then increases again at long lengths of ownership. This might be the case as older householders leave for elder care homes or die.
- Chart D shows increased turnover at specific lengths of ownership. The idea here is that certain lengths of ownership are associated with certain events, such as children graduating from the public school, retirement, and deaths.

We think these four shapes to the housing turnover schedule cover most of what we are likely to find. The four shapes give vastly different distributions for a neighborhood's length of ownership, as we will show later in the chapter. First, though, we show what the empirical evidence says about housing turnover rates.

Figure 1

Chart A

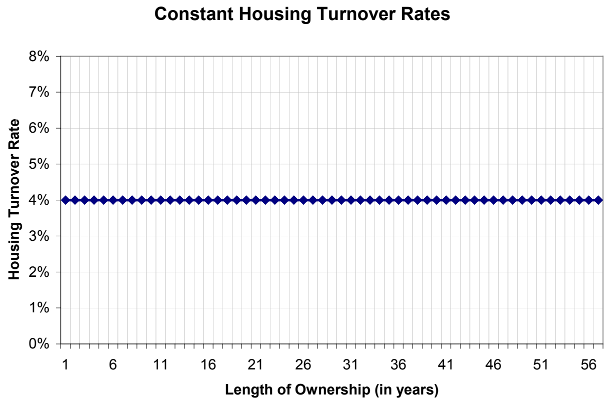


Chart C

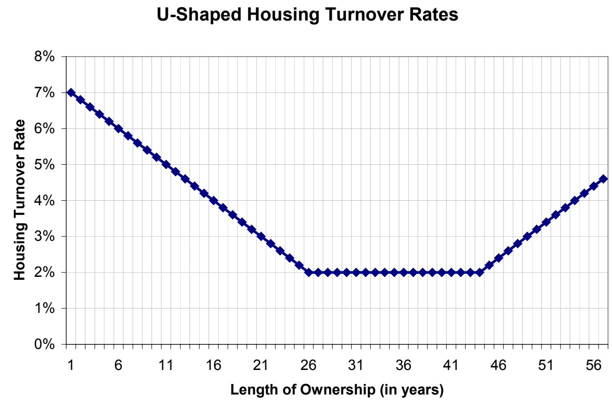


Chart B

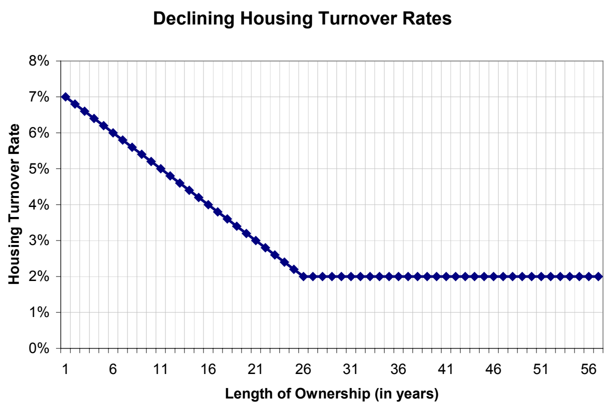
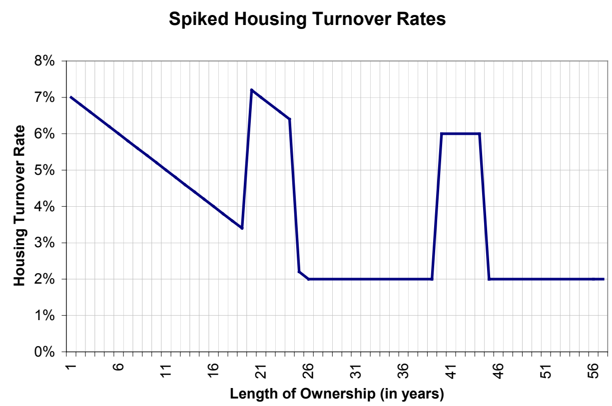


Chart D



Empirical Research
Actually measuring the housing turnover rates by length of ownership is tricky, to say the least. It has only been recently possible to do this with digitized parcel data that provide multiple (historical) sales dates for each parcel in a county or tax rate area.[3] We have measured housing turnover in one school district where we had all sales dates from 1976 through 2006 for each SFU in the district.

For this school district, we looked at each "cohort of housing" by when it sold. For example, we looked at all the houses that sold in 1976 and followed them over time to measure their turnover rate by length of ownership. We have turnover rates as these houses aged for 31 years. Then we took the houses that sold in 1977 and calculated their housing turnover rates by length of ownership. And so on, for each sales cohort. Note that a house could be in several cohorts. If a home sold in 1976, 1977, and finally in 1980, it would show up in all three cohorts of homes. It would contribute to the one-year turnover rate in the 1976 cohort, to the three-year turnover rate in the 1977 cohort, and would be part of the homes that had not yet sold in the 1980 cohort.

Figure 2 shows the results of our analysis for the oldest ten housing cohorts in our example. The data show that turnover rates are high the first few years that a home is owned. Turnover rates decline with length of ownership: the longer a home is owned, the less likely it will be sold.

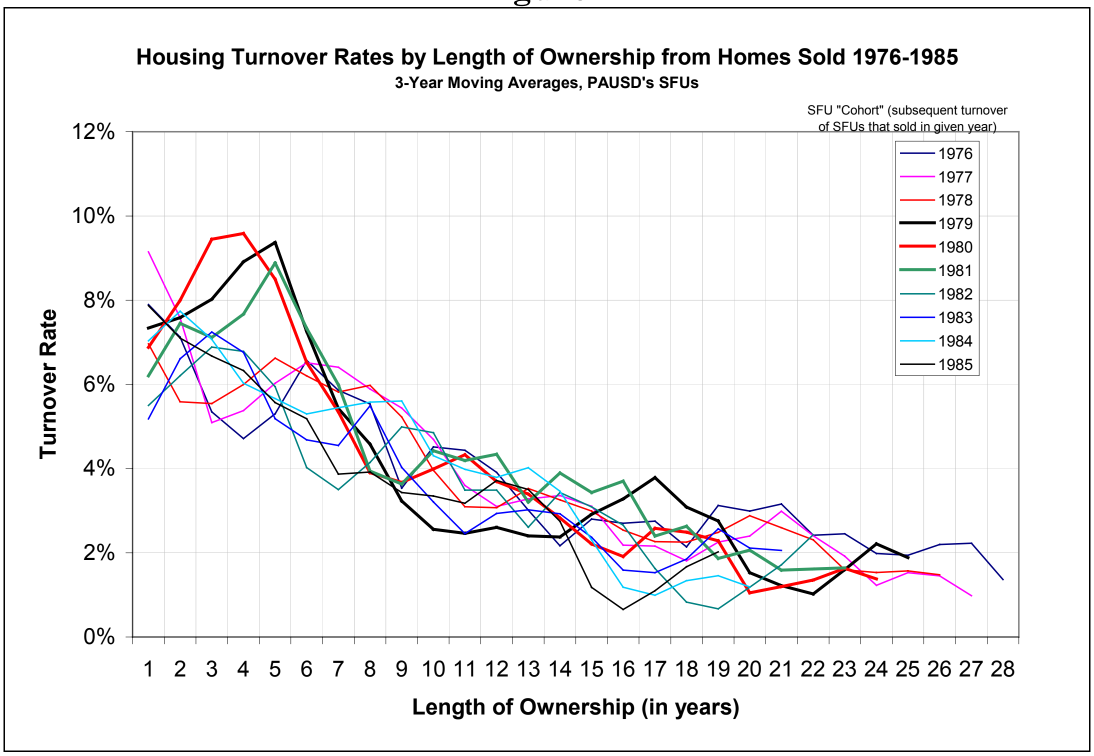
Each line on the chart represents the housing turnover rates from each cohort of sales. We took a three-year moving average, as the rates are subject to a lot of random variation. While rates vary a lot by cohort and there is still a good amount of random variation, it seems clear that the basic shape of the schedule is as we stated above: high rates at recent changes in ownership, followed by steadily declining rates. We also found period effects in the data – that certain years had particularly high or low rates of turnover for most lengths of ownership. In the data for our client, 1979-1981 showed particularly high turnover rates for most lengths of ownership. This is likely due to economic circumstances.

Unfortunately, we do not have housing turnover data for lengths of ownership greater than 30 years. As we illustrated above in Chart C (the U-shaped housing turnover schedule), it might be possible, and some people

[3] One could also calculate housing turnover rates with two consecutive years of parcel data and a last sales date in each. The homes that change ownership in the second year could be used for the numerator, while the data in the first year could provide the denominator for the turnover rate.

think likely, that housing turnover rates need to increase at some point. We have found no empirical evidence one way or another.

Figure 2



Simulations

The housing turnover rates determine a distribution of the length of home ownership in a neighborhood. We illustrate this point using simulations. We start with a hypothetical neighborhood of 1,000 SFUs, all built during the same year. This is an attempt to mirror a new subdivision. How will its length-of-ownership distribution change as the subdivision ages?

We age the houses, applying housing turnover rates. [Alvin: show] If a house changes ownership, it starts at zero years of ownership and drops out of its cohort, while the rest of the units in the cohort continue aging into the next length of ownership. (This is the same process as discussed at the beginning of the chapter for forecasting real housing populations.)

We aged the 1,000 housing units using five different sets of housing turnover rates (the four shown in Figure 1 plus an additional constant rate). These simulations provided a length of ownership distribution for each projection year. Eventually,[4] a stable state is achieved in which the length of ownership distribution does not change.

[4] How long it takes to reach a stable state depends on the housing turnover rates. Practically speaking, this is usually achieved within 50 to 75 years after the development is built.

Because enrollments are low for homes owned 20 or more years (see Figure x, chapter 4b.2), a key statistic of the length of ownership distribution is the number of homes with 20 or more years of ownership. A neighborhood with a high percentage of homes owned more than 20 years will have much lower enrollments than a neighborhood with a low percentage of homes owned more than 20 years. Figure 3 shows the number of homes owned 20 or more years over time for each housing turnover schedule.

Obtaining Data on the Current Length of Ownership of Houses
We use digitized assessor's parcel data to obtain data on length of ownership. The parcel data often contain the last sales date of a property, and, by subtraction from the current date, one can calculate length of ownership.

There can be two problems in using parcel sales dates. First, some "sales" are essentially paper transactions (changes in title) and do not reflect a real change of household occupancy or ownership. For example, when homes are put in a trust, the recording of the deed can trigger a sales date when, in fact, no one has moved and there has been no change in household status. Similarly, houses might be bought by or transferred to younger relatives (for tax and other purposes) while the original householder remains in the house. Marriages and divorce can also trigger sales dates even though the original householder remains. All of these sorts of transfers or title changes are not what we want. We want to know when a change in occupancy occurs. The assessor's data in one county we worked with was able to distinguish among these different types of "sales," so this was not a problem. For some counties, we have had to use sales dates that included these paper transfers. In other cases, it may be possible to look at sale amounts and other information in the parcel data to eliminate these paper sales. This is only useful if the file contains several past sales dates. If so, one eliminates the recent sale date but can pick up the previous sales date.

The second problem that we have encountered in using digitized sales dates is that the dates are not always available for early years. In one county, sales dates included in the digitized records went back only to 1989, another had dates back to 1976, and yet another had dates back to the late 1960s. Sitting now in 2007, the 1989 dates give us sales transactions from the last 17 years. The 1976 data are much better, providing more than 30 years of sales information. Thus, we do not have data for calculating the probability of housing turnover for very, very long-held homes. This is actually a serious issue because a large proportion of homes are often held for more than 30 years. Having 30 percent of the housing stock held more than 30 years is typical among our clients.

Figure 3

Chart A1

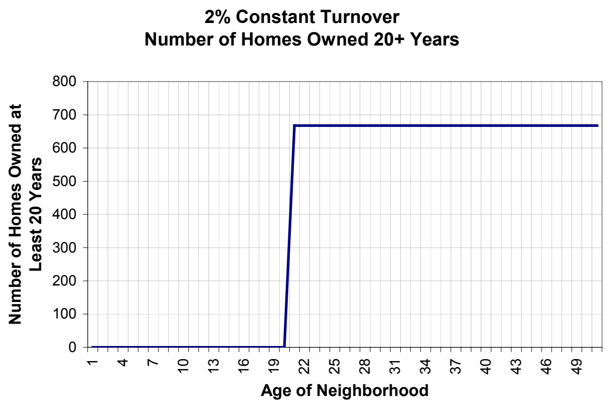


Chart C

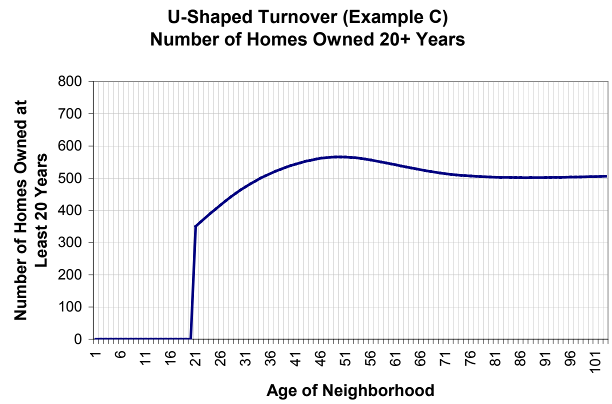


Chart A2

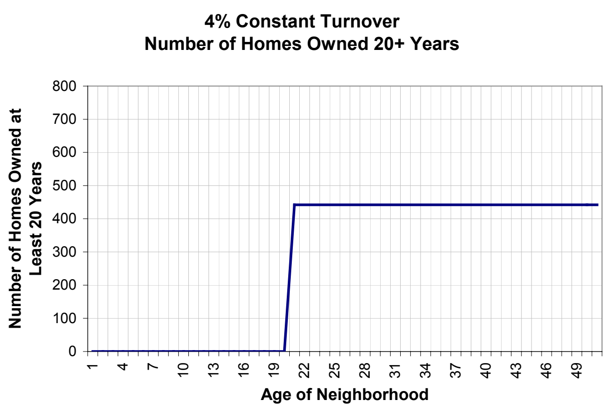


Chart D

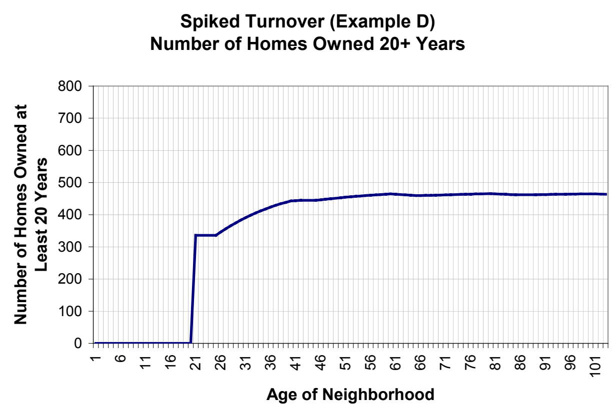


Chart B

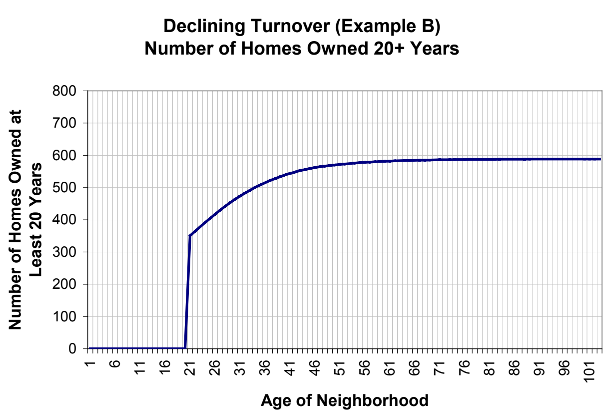


Chart All Simulations

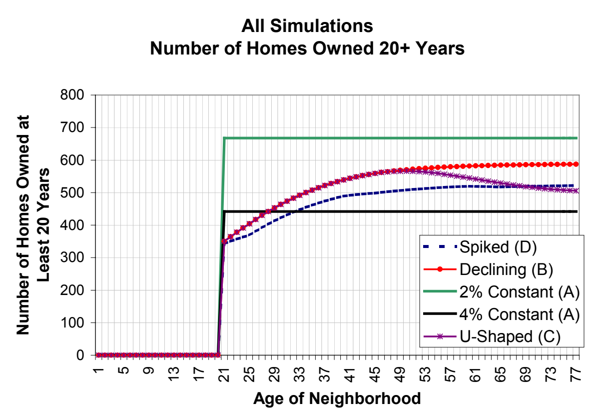


Table 4 summarizes the differences in long-held homes among the five simulations. The numbers generated by the two constant rates frame the range of outcomes. With a four percent turnover rate, 44 percent of the homes have 20 plus years of ownership; with a two percent turnover rate, 67 percent have 20 plus years of ownership.

Simulation B, the most realistic schedule based on our current knowledge, has 59 percent of the units with 20 or more years of ownership. Although this schedule uses a long-run turnover rate of two percent, it results in a lot fewer houses held 20 or more years compared to a constant turnover rate of two percent at all lengths of ownership. This is as we would expect – the higher turnover rates at the earlier lengths of ownership keep more homes circulating.

Simulation C, which assumes that turnover rates increase for long lengths of ownership, is of particular interest because it shows one way that older neighborhoods can have changing enrollments. The number of long-held homes peaks in about 50 years after the development is built, then declines. By 75 years, a stable state has been achieved. When the number of homes held 20+ years peaks, then enrollments at this point should be at their lowest level. Enrollments then increase between 50 and 75 years of the development's life, as more homes leave the 20+ category.

Simulation D, with spiked turnover rates, is one way to model neighborhood life cycles, the subject of the next chapter. The number of homes owned 20+ years has a time trajectory similar to that in Simulation B, but the level is different. Simulation D has fewer homes in the 20+ category than Simulation B. This is as expected because the spiked rates result in higher turnover.[5]

The two main results that the simulations illustrated are: (1) the turnover rate *level* strongly affects the number of long-held homes; and (2) if turnover rates increase at older lengths of ownership, then enrollments will rise in older neighborhoods (when the neighborhood is between 50 and 75 years old).[6]

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[5] We experimented with different ways to spike the turnover rates. For example, we tried smaller spikes and less frequent spikes. The time trajectory of 20+ owned homes remained pretty similar, no matter what we did to the spikes. Only the level changed. That is, with fewer spikes or smaller spikes, the number of long-held homes increased.

[6] This timing depends on when the turnover rates actually increase.

Table 4

Number of Houses with 20+ Years of Ownership, Out of 1,000 units

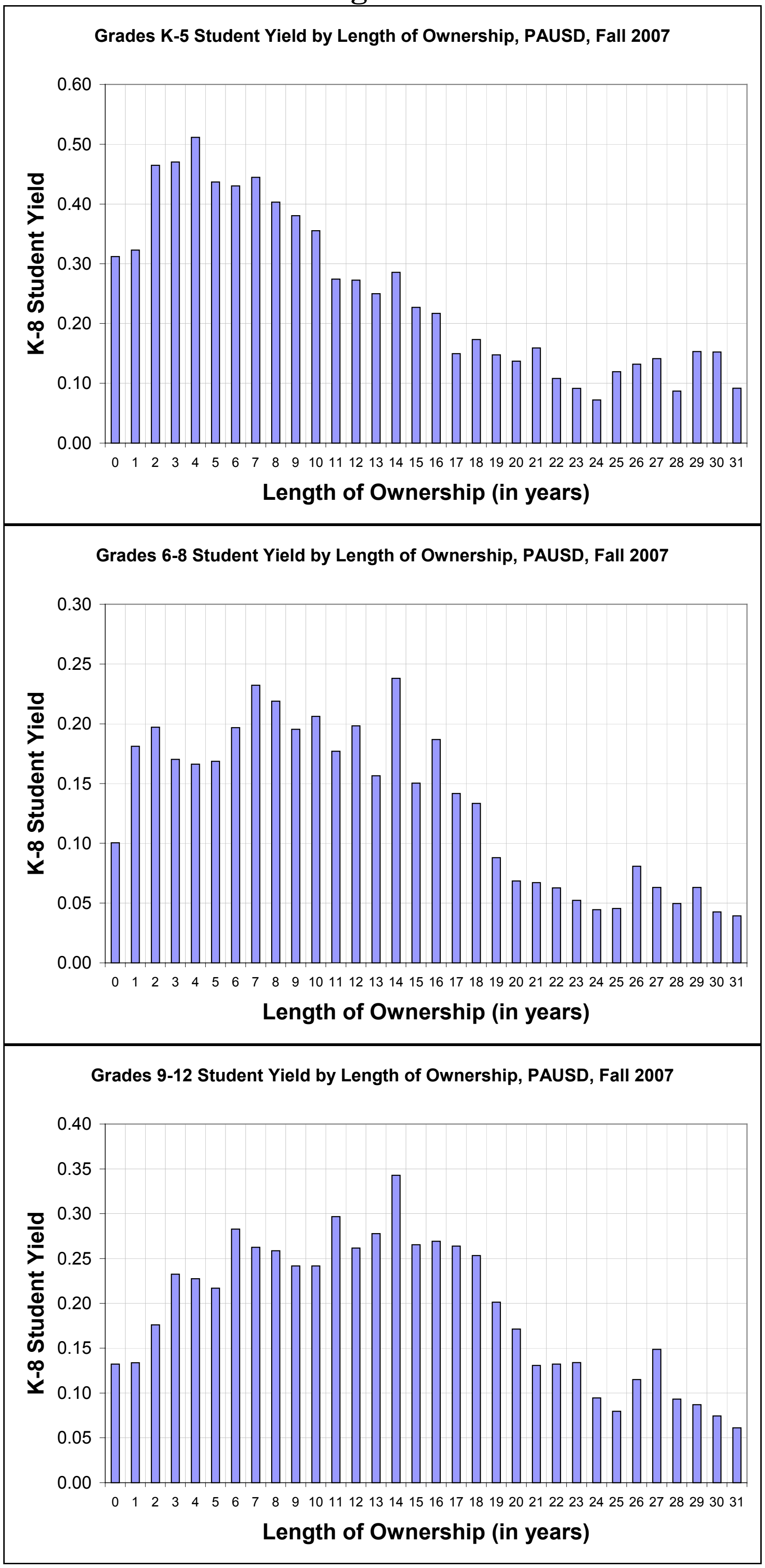
		Number of Homes Owned 20+ Years in Stable State	Time to Stability
A1	Constant 2%	668	Stability achieved in 20 years
A2	Constant 4%	442	Stability achieved in 20 years
B	Declining	589	Stability achieved in about 50 years
C	U-Shaped	509 (peak 566)	Peak at 50 years; stability at 75 years
D	Spiked	486	Stability achieved after 50 years

Student Yields by Length of Ownership

Student yields by length of ownership were measured for one of our school district clients in an affluent, high-performing suburban area. Figure 4 shows student yields by length of ownership for three different grade levels. The top chart shows K-5 yields, which are high between three and 10 years of ownership. The middle chart shows 6-8 yields, which are high between one and 16 years of ownership. The bottom chart shows 9-12 yields that are high between three and 18 years of ownership. By 20 years of ownership, K-8 yields are quite low and 9-12 yields are fairly low.

These yields are similar to what we have observed in other, quite affluent districts with high-test scores. It is possible that urban areas of less desirable districts could have a somewhat different pattern. We encourage school demographers to measure the district's yields by length of ownership in order to gain a greater understanding of the pattern existing in their particular district.

Figure 4


Grades K-5 Student Yield by Length of Ownership, PAUSD, Fall 2007
K-8 Student Yield
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Length of Ownership (in years)
Grades 6-8 Student Yield by Length of Ownership, PAUSD, Fall 2007
K-8 Student Yield
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Length of Ownership (in years)
Grades 9-12 Student Yield by Length of Ownership, PAUSD, Fall 2007
K-8 Student Yield
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Length of Ownership (in years)

Student yields by length of ownership are relatively easy to calculate if assessor's parcel data that provide last sales date are available. The parcel data must be joined to the student address database.

Practically speaking, we use student yields by length of home ownership measured in a school district and assume that these student yields will continue in the future. We know, however, that student yields can change over time due to a number of factors. Yields can change depending on the percentage of children in the general population, when the demographics of a community change, such as a change in the migration of ethnic groups with large household sizes, and if the reputation of the district changes. An ambitious school demographer could try to predict these changes, and hence model changing student yields by length of ownership in the forecast.

As school demographers research yields by length of ownership, we will be in a better position to see how stable these rates actually are. Other than the research we have conducted for our clients, we have not seen data on student yields by length of ownership. This is a new research area because it requires that both address data and parcel data be combined. (Census data are not detailed enough to measure student yields by length of ownership.)

Applying Student Yields to the Length-of-Ownership Distribution

Once we have the predicted length of ownership distribution, we can apply student yields to obtain an enrollment forecast. The top part of Table 5 uses the length of ownership forecast shown earlier in the chapter (Figure 3). The bottom part of Figure 8 is the result of multiplying the length of ownership distribution by the student yields.

In this example, the number of 32+ houses is projected to increase over time, suggesting that enrollments are likely to decline during the forecast period. Without actually multiplying student yields by the homes at each length of ownership, we would expect enrollments to decline. And indeed, when we multiplies the student yield (left-most column) by the housing distribution above, the resulting projected number of students living at each length of ownership is declining. The enrollment total – shown in the last row of the table –shows an expected decline from 7,289 to 6,457 students.

Table 5

Forecast of Length of Ownership and Enrollments

Yrs of Ownership	Turnover Rate	Actual Number of SFUs by Length of ownership, Time T	Forecast of the Distribution of SFUs by Length of Ownership							
			Time T+1	Time T+2	Time T+3	Time T+4	Time T+5	Time T+6	Time T+7	Time T+8
0	7.0%	**389**	430	424	420	416	413	410	407	405
1	7.1%	**351**	362	400	394	390	387	384	381	379
2	6.8%	**284**	326	336	371	366	363	359	357	354
3	6.8%	**370**	265	304	313	346	341	338	335	332
4	6.7%	**391**	345	247	283	292	322	318	315	312
5	6.0%	**332**	365	322	230	264	272	301	297	294
6	5.2%	**244**	312	343	303	216	248	256	283	279
7	4.9%	**297**	231	296	325	287	205	235	243	268
8	4.3%	**402**	282	220	281	309	273	195	224	231
9	4.0%	**389**	385	270	211	269	296	261	187	214
10	3.5%	**422**	374	369	260	202	259	284	251	179
11	3.5%	**401**	407	360	356	250	195	250	274	242
12	3.2%	**363**	387	393	348	344	242	188	241	265
13	3.0%	**396**	351	375	380	337	333	234	182	233
14	2.6%	**420**	384	341	363	369	327	323	227	177
15	2.2%	**339**	409	374	332	354	359	318	314	221
16	2.1%	**364**	331	400	365	324	346	351	311	307
17	2.0%	**254**	356	324	391	358	317	339	344	304
18	2.1%	**300**	249	349	318	383	351	311	332	337
19	1.9%	**318**	294	244	342	311	375	343	304	325
20	2.1%	**321**	312	288	239	335	305	368	336	298
21	1.9%	**283**	314	305	282	234	328	299	360	329
22	1.8%	**287**	278	308	300	276	229	322	293	353
23	1.7%	**306**	282	273	303	294	272	225	316	288
24	1.7%	**180**	301	277	268	298	289	267	222	311
25	1.7%	**176**	177	296	272	263	293	284	262	218
26	1.6%	**235**	173	174	291	268	259	288	279	258
27	1.4%	**269**	231	170	171	286	263	255	283	275
28	1.4%	**322**	265	228	168	169	282	260	251	279
29	1.4%	**274**	318	262	225	166	166	278	256	248
30	1.4%	**211**	270	313	258	222	163	164	274	253
31	1.4%	**229**	208	267	309	255	219	161	162	271
32+	1.4%	**5,911**	6,056	6,179	6,358	6,576	6,738	6,862	6,927	6,993
Total		**16,030**	16,030	16,030	16,030	16,030	16,030	16,030	16,030	16,030

Yrs of Ownership	Student Yield	Actual Number of Students, Time T	Forecast of Enrollments: Student Yield multiplied by the number of homes by length of ownership							
			Time T+1	Time T+2	Time T+3	Time T+4	Time T+5	Time T+6	Time T+7	Time T+8
0	0.54	**212**	234	231	229	227	225	223	222	220
1	0.64	**224**	231	255	252	249	247	245	243	241
2	0.84	**238**	273	282	311	307	304	301	299	297
3	0.87	**323**	231	265	273	302	298	295	292	290
4	0.91	**354**	312	223	256	264	292	288	285	282
5	0.82	**273**	300	265	189	217	224	247	244	241
6	0.91	**222**	284	312	275	197	226	233	257	254
7	0.94	**279**	217	278	305	269	193	221	228	252
8	0.88	**354**	249	194	248	272	240	172	197	203
9	0.82	**318**	315	221	172	220	242	213	153	175
10	0.80	**339**	300	297	209	162	208	228	201	144
11	0.75	**300**	305	270	267	187	146	187	205	181
12	0.73	**266**	284	288	255	252	177	138	177	194
13	0.68	**271**	240	256	260	230	228	160	125	160
14	0.87	**364**	333	295	315	320	283	280	197	153
15	0.64	**218**	263	240	213	227	231	204	202	142
16	0.67	**245**	223	269	246	218	233	236	209	207
17	0.56	**141**	198	180	217	199	176	188	191	169
18	0.56	**168**	139	196	178	215	196	174	186	189
19	0.44	**139**	128	106	149	136	164	150	133	142
20	0.38	**121**	118	109	90	126	115	139	127	113
21	0.36	**101**	112	109	101	83	117	107	129	118
22	0.30	**87**	84	93	91	84	70	98	89	107
23	0.28	**85**	78	76	84	82	75	63	88	80
24	0.21	**38**	64	59	57	63	61	56	47	66
25	0.24	**43**	43	72	67	64	71	69	64	53
26	0.33	**77**	57	57	95	88	85	94	92	84
27	0.35	**95**	82	60	60	101	93	90	100	97
28	0.23	**74**	61	52	39	39	65	60	58	64
29	0.30	**83**	96	79	68	50	50	84	78	75
30	0.27	**57**	73	84	70	60	44	44	74	68
31	0.19	**44**	40	51	59	49	42	31	31	52
32+	0.19	**1,136**	1,164	1,187	1,222	1,264	1,295	1,318	1,331	1,344
Total		**7,289**	7,130	7,012	6,922	6,824	6,715	6,637	6,551	6,457

Conclusion

This paper presented an alternative enrollment forecast model that explicitly accounted for the effects of housing turnover. We modified the Housing Unit Method by characterizing housing and student yields by their length of ownership.

This alternative model is a recent addition to our tool box. Only recently have data been available to measure student yields and housing turnover rates by length of ownership. In fact, data for these purposes are often still not available or of poor quality. In some counties, however, enough data are now available to produce these alternative forecasts.

We use these forecasts as an independent test of the more traditional cohort survival model applied to enrollment forecasting. If the two forecasts agree, we can be more confidence in our enrollment forecasts. If the two forecasts do not agree, the forecaster can evaluate the grade progressions and Kindergarten/Birth ratios used in the cohort survival projection and perhaps decide to choose other assumptions. In other words, it can guide the forecaster in choosing their assumptions in the cohort survival forecast.

As more empirical research is conducted on housing turnover rates, we will learn just how reliable this alternative forecast method is. For very long-term forecasts, it may prove to be more reliable than the cohort survival method.