Practice in School Enrollment Projections

Xiaomin Ruan

Follow this and additional works at: http://digitalrepository.unm.edu/bber

Recommended Citation

This Presentation is brought to you for free and open access by the Museums and Research Centers at UNM Digital Repository. It has been accepted for inclusion in Bureau of Business and Economic Research by an authorized administrator of UNM Digital Repository. For more information, please contact disc@unm.edu.
PRACTICE IN SCHOOL ENROLLMENT PROJECTIONS

Xiaomin Ruan

For 13th NM Data User Conference
Geospatial & Population Studies
University of New Mexico
Nov. 2011
Challenges to Small Area Population Estimation/Projections

- Smaller the area is, more variant each age cohort is.

- Smaller the area is, more variant each demographic component is, like birth, death, migration, etc.

- The smaller the area is, less data resource is available for estimation models, and less financial resource to local data users.
Challenges to NM School Enrollment Projections

- Each grade level enrollment needs to be summed up to match school total enrollment, and each school level enrollment needs to be summed up to match school district enrollment.

- Each grade level enrollment each year needs to be compatible with lower grade level in previous year, at both school and school district level.

- Varying tendency in birth and migration in border state like NM makes first grade or kindergarten enrollment hard to predict.
Key Points to Forecast School Enrollment

- Grade progression ratio, if stable and reliable, can be used to predict higher grade enrollments.

- For the starting grade, like grade 9 in high school or kindergarten or grade 1, birth data would be the first source to explore when we are trying to capture future enrollment dynamics.

- As a border state, NM school and school districts also face migration changes, which may be a strong factor when we forecasts school enrollments.
Two School District Examples: Clovis and Central
Clovis Municipal Schools Facts

- Clovis Municipal Schools has 8,415 students in SY 2010-11. It serves 1 high school, 3 Jr. high schools, and 13 elementary schools.

- Located in Curry County, Clovis District enrollment is heavily affected by group quarters like Cannon Air Force Base.
Clovis Municipal Schools Historical Enrollment

![Total Enrollment Graph]

- Years: 1986 to 2009
- Enrollment Ranges: 6800 to 8800
Data Preparation

- County level live birth data were distributed to each school district according to geocoding results and birth-age mothers’ shares, and then averaged by 3 years to smooth out bumps.

- Each grade enrollment at each school and school district level were averaged in 3 years.

- Actual grade progression ratios are calculated from SY1986-87 to SY2009-10, all-yr, 15-yr, 10-yr, and 5-yr averages are calculated.

- Sam cohort kg/birth, g01/birth, g07/birth, and g09/birth are calculated and pictured.
Neither 3-yr average birth nor the same cohort kg/birth ratio showed any trend stable enough to be the basis for forecasting.
The grade progression ratios, however, demonstrated very stable trends over time, provided a solid basis to use grade progression for higher grades.
A simple OLS regression model is applied to each school’s kindergarten enrollment. Then all the school regression results are summed up and averaged with the school district level kindergarten enrollment regression outcome.

Whenever kindergarten enrollment is not stable, grade one is used in regression instead.
Other Grade Enrollment Projection

The averaged kindergarten enrollment forecasts are then multiplied with each grade progression ratio to derive the second or higher grade enrollment, both at school level and school district level.

After all grade enrollment forecasts are developed, the sum total from all schools is compared against the school district forecasts to make sure their trends are consistent.
Model Validation

The validation data is the average of school level and district level against actual enrollments using three most recent school years.

<table>
<thead>
<tr>
<th></th>
<th>SY2008</th>
<th>SY2009</th>
<th>SY2010</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Enrollment</td>
<td>7965</td>
<td>7966</td>
<td>8354</td>
<td></td>
</tr>
<tr>
<td>Estimated</td>
<td>7987</td>
<td>8187</td>
<td>8895</td>
<td></td>
</tr>
<tr>
<td>Percentage Diff.</td>
<td>0.28%</td>
<td>2.77%</td>
<td>6.48%</td>
<td>3.18%</td>
</tr>
</tbody>
</table>

After SY 2010-11 enrollment data published, we compared our projections against the newly data as well.

<table>
<thead>
<tr>
<th></th>
<th>SY2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Enrollment</td>
<td>8415</td>
</tr>
<tr>
<td>Projected</td>
<td>8391</td>
</tr>
<tr>
<td>Percentage Diff.</td>
<td>-0.29%</td>
</tr>
</tbody>
</table>
Projection Trend

Historical and Forecasted Total School Enrollments: Clovis Municipal Schools

- **Historical**
- **Future**

Legend:
- **High Scenario**
- **Most Likely Scenario**
- **Low Scenario**

Yearly Enrollment by Scenario:
- **High Scenario**
- **Most Likely Scenario**
- **Low Scenario**

Data spans from SY2001 to SY2020.
Central Consolidated Schools has 6,274 students in SY 2010-11. It serves 4 high schools, 3 middle schools, and 10 elementary schools.

Located in San Juan County, Central District enrollment is affected migrations between San Juan and McKinley among Navajo nations.
Central Municipal Schools Historical Enrollment

Total Enrollment

<table>
<thead>
<tr>
<th>Year</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>5000</td>
</tr>
<tr>
<td>1988</td>
<td>5500</td>
</tr>
<tr>
<td>1990</td>
<td>6000</td>
</tr>
<tr>
<td>1992</td>
<td>6500</td>
</tr>
<tr>
<td>1994</td>
<td>7000</td>
</tr>
<tr>
<td>1996</td>
<td>7500</td>
</tr>
<tr>
<td>1998</td>
<td>8000</td>
</tr>
<tr>
<td>2000</td>
<td>7500</td>
</tr>
<tr>
<td>2002</td>
<td>7000</td>
</tr>
<tr>
<td>2004</td>
<td>6500</td>
</tr>
<tr>
<td>2006</td>
<td>6000</td>
</tr>
<tr>
<td>2008</td>
<td>5500</td>
</tr>
</tbody>
</table>
Data Preparation

- County level live birth data were distributed to each school district according to geocoding results and birth-age mothers’ shares, and then averaged by 3 years to smooth out bumps.

- Each grade enrollment at each school and school district level were averaged in 3 years.

- Actual grade progression ratios are calculated from SY1986-87 to SY2009-10, all-yr, 15-yr, 10-yr, and 5-yr averages are calculated.

- Sam cohort kg/birth, g01/birth, g06/birth, and g09/birth are calculated and pictured.
Again, neither 3-yr average birth nor kg/birth ratio showed any stable trend that might be used as the basis for forecasting.
The grade progression ratios, however, demonstrated stable trends over time, provided a solid basis to use grade progression for higher grades.
Solution for Grade 01, Grade 06, and Grade 09, Samples

**District Total g01**

$y = -8.936x + 618.9$

$R^2 = 0.845$

**Newcomb Middle g06**

$y = -2.298x + 88.60$

$R^2 = 0.945$

**Kirtland Central High g09**

$y = -7.337x + 334.4$

$R^2 = 0.900$
Other Grade Enrollment Projection

The averaged kindergarten or first grade enrollment forecasts are then multiplied with averaged grade progression ratio to derive the second or higher grade enrollment, both at school level and school district level.

After all grade enrollment forecasts are developed, the sum total from all schools is compared against the school district forecasts to make sure their trends are consistent.
The validation data is the average of school level and district level against actual enrollments using three most recent school years.

<table>
<thead>
<tr>
<th>Actual Enrollment</th>
<th>SY2008</th>
<th>SY2009</th>
<th>SY2010</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected</td>
<td>6,577</td>
<td>6,402</td>
<td>6,015</td>
<td></td>
</tr>
<tr>
<td>Percentage Diff.</td>
<td>1.36%</td>
<td>1.20%</td>
<td>-2.29%</td>
<td>0.09%</td>
</tr>
</tbody>
</table>

After SY 2010-11 enrollment data published, we compared our projections against the newly data as well.

<table>
<thead>
<tr>
<th>Actual Enrollment</th>
<th>SY2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected</td>
<td>6274</td>
</tr>
<tr>
<td>Percentage Diff.</td>
<td>-0.13%</td>
</tr>
</tbody>
</table>
Projection Trend

Historical and Forecasted Central Consolidated Schools Enrollments

- Historical
- Most Likely
- High Scenario
- Low Scenario

40th Day

SY2001-2020
## Model Validation for 28 School Districts

<table>
<thead>
<tr>
<th>SD Name</th>
<th>Actual Enrollment</th>
<th>Validation from projection</th>
<th>Ave Validation %</th>
<th>SY2011 Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserve</td>
<td>184 169 179</td>
<td>197 172 196</td>
<td>6.11%</td>
<td>173 188 8.70%</td>
</tr>
<tr>
<td>Floyd</td>
<td>240 233 235</td>
<td>244 228 239</td>
<td>0.41%</td>
<td>226 228 0.81%</td>
</tr>
<tr>
<td>Tatum</td>
<td>284 301 307</td>
<td>299 318 327</td>
<td>5.81%</td>
<td>315 313 -0.76%</td>
</tr>
<tr>
<td>Mesa Vista</td>
<td>419 401 384</td>
<td>394 393 406</td>
<td>-0.74%</td>
<td>392 363 -7.34%</td>
</tr>
<tr>
<td>Questa</td>
<td>509 533 513</td>
<td>492 517 484</td>
<td>-3.98%</td>
<td>511 517 1.20%</td>
</tr>
<tr>
<td>Capitan</td>
<td>534 496 508</td>
<td>518 451 475</td>
<td>-6.19%</td>
<td>510 491 -3.65%</td>
</tr>
<tr>
<td>Clayton</td>
<td>531 586 574</td>
<td>505 611 600</td>
<td>1.30%</td>
<td>550 580 5.46%</td>
</tr>
<tr>
<td>Eunice</td>
<td>566 582 582</td>
<td>621 654 705</td>
<td>14.41%</td>
<td>576 582 1.06%</td>
</tr>
<tr>
<td>Lordsberg</td>
<td>663 650 600</td>
<td>648 616 605</td>
<td>-2.22%</td>
<td>578 584 0.95%</td>
</tr>
<tr>
<td>Estancia</td>
<td>869 839 796</td>
<td>899 834 847</td>
<td>3.09%</td>
<td>867 861 0.70%</td>
</tr>
<tr>
<td>Raton</td>
<td>1,337 1,299 1,282</td>
<td>1,321 1,301 1,280</td>
<td>-0.40%</td>
<td>1,249 1,245 -0.32%</td>
</tr>
<tr>
<td>Cobre</td>
<td>1,381 1,374 1,297</td>
<td>1,404 1,400 1,285</td>
<td>0.88%</td>
<td>1,287 1,279 -0.66%</td>
</tr>
<tr>
<td>Las Vegas</td>
<td>2,077 1,989 1,928</td>
<td>2,172 2,016 1,959</td>
<td>2.51%</td>
<td>1,885 1,927 2.24%</td>
</tr>
<tr>
<td>Pojoaque</td>
<td>2,007 1,964 1,964</td>
<td>2,000 1,940 1,956</td>
<td>-0.66%</td>
<td>2,035 1,997 -1.87%</td>
</tr>
<tr>
<td>Taos</td>
<td>3,028 3,035 3,030</td>
<td>2,994 3,064 3,069</td>
<td>0.37%</td>
<td>2,963 2,975 0.41%</td>
</tr>
<tr>
<td>Los Alamos</td>
<td>3,424 3,350 3,362</td>
<td>3,349 3,426 3,579</td>
<td>2.18%</td>
<td>3,410 3,362 -1.40%</td>
</tr>
<tr>
<td>Espanola</td>
<td>4,522 4,379 4,384</td>
<td>4,722 4,541 4,509</td>
<td>3.66%</td>
<td>4,333 4,277 -1.29%</td>
</tr>
<tr>
<td>Belen</td>
<td>4,709 5,078 5,174</td>
<td>4,774 5,015 5,247</td>
<td>0.52%</td>
<td>4,627 4,792 3.56%</td>
</tr>
<tr>
<td>Central</td>
<td>6,489 6,326 6,156</td>
<td>6,577 6,402 6,015</td>
<td>0.09%</td>
<td>6,274 6,266 -0.13%</td>
</tr>
<tr>
<td>Alamos</td>
<td>6,266 6,073 6,124</td>
<td>6,097 6,053 5,889</td>
<td>-2.29%</td>
<td>6,291 5,989 -4.81%</td>
</tr>
<tr>
<td>Clovis</td>
<td>7,965 7,966 8,354</td>
<td>7,987 8,187 8,895</td>
<td>3.18%</td>
<td>8,391 8,415 0.28%</td>
</tr>
<tr>
<td>Los Lunas</td>
<td>8,445 8,489 8,442</td>
<td>8,374 8,378 8,279</td>
<td>-1.36%</td>
<td>8,469 8,469 0.00%</td>
</tr>
<tr>
<td>Roswell</td>
<td>9,297 9,484 9,780</td>
<td>9,245 9,530 9,995</td>
<td>0.71%</td>
<td>9,903 9,989 0.87%</td>
</tr>
<tr>
<td>Gallup</td>
<td>12,133 12,023 11,776</td>
<td>12,257 12,048 11,838</td>
<td>0.59%</td>
<td>11,717 11,641 -0.64%</td>
</tr>
<tr>
<td>Gadsden</td>
<td>13,819 13,685 13,859</td>
<td>13,644 13,130 12,866</td>
<td>-4.16%</td>
<td>13,904 14,302 2.86%</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>13,296 13,442 13,684</td>
<td>12,953 13,340 13,837</td>
<td>-0.74%</td>
<td>13,988 13,774 -1.53%</td>
</tr>
<tr>
<td>Rio Rancho</td>
<td>15,502 15,828 16,320</td>
<td>15,074 15,793 16,513</td>
<td>-0.60%</td>
<td>16,530 17,332 4.85%</td>
</tr>
<tr>
<td>Las Cruces</td>
<td>23,190 22,999 23,542</td>
<td>23,429 23,346 24,299</td>
<td>1.92%</td>
<td>24,597 23,721 -3.56%</td>
</tr>
</tbody>
</table>
| Average Percentage Difference | 0.87% | 1.80% | 1.13% |}

Average Percentage Difference: 0.87%
Model Validation for 28 School Districts, continued

<table>
<thead>
<tr>
<th>Grade</th>
<th>Actual Enrollment</th>
<th>Projected</th>
<th>Diff.</th>
<th>% Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG</td>
<td>12038</td>
<td>11744</td>
<td>-294</td>
<td>-2.4%</td>
</tr>
<tr>
<td>G01</td>
<td>12025</td>
<td>11958</td>
<td>-67</td>
<td>-0.6%</td>
</tr>
<tr>
<td>g02</td>
<td>11662</td>
<td>11747</td>
<td>85</td>
<td>0.7%</td>
</tr>
<tr>
<td>g03</td>
<td>11584</td>
<td>11554</td>
<td>-29</td>
<td>-0.3%</td>
</tr>
<tr>
<td>g04</td>
<td>11501</td>
<td>11424</td>
<td>-77</td>
<td>-0.7%</td>
</tr>
<tr>
<td>g05</td>
<td>11406</td>
<td>11344</td>
<td>-62</td>
<td>-0.5%</td>
</tr>
<tr>
<td>g06</td>
<td>11295</td>
<td>11350</td>
<td>55</td>
<td>0.5%</td>
</tr>
<tr>
<td>g07</td>
<td>11025</td>
<td>10880</td>
<td>-145</td>
<td>-1.3%</td>
</tr>
<tr>
<td>g08</td>
<td>10801</td>
<td>10746</td>
<td>-55</td>
<td>-0.5%</td>
</tr>
<tr>
<td>g09</td>
<td>12542</td>
<td>12690</td>
<td>147</td>
<td>1.2%</td>
</tr>
<tr>
<td>g10</td>
<td>11398</td>
<td>11478</td>
<td>80</td>
<td>0.7%</td>
</tr>
<tr>
<td>g11</td>
<td>9838</td>
<td>9887</td>
<td>49</td>
<td>0.5%</td>
</tr>
<tr>
<td>g12</td>
<td>9437</td>
<td>9657</td>
<td>220</td>
<td>2.3%</td>
</tr>
<tr>
<td>Total</td>
<td>146551</td>
<td>146459</td>
<td>-92</td>
<td>-0.1%</td>
</tr>
</tbody>
</table>

This table is the validation for all 28 school districts projections at each grade level using SY2010-11 actual data. Even though the total percentage error is as small as -0.1%, there are still some grades showing much larger variations than the other, like KG or grade 9 or grade 12.
QUESTIONS OR COMMENTS?

Contact: Xiaomin Ruan
xmruan@unm.edu
(505)277-3541