Statistical Issues and Interpretation of the American Community Survey's One-, Three-, and Five-Year Period Estimates

Michael Beaghen, Lynn Weidman
U.S. Bureau of the Census
4600 Silver Hill Rd., Washington, DC 20233-9001

1. Introduction[1]

The Census Bureau began full implementation of the American Community Survey (ACS) in 2005. The ACS will replace the function of the decennial long form, obtaining comparably detailed information released annually. While the long form represented a snapshot in time, April 1, 2000, the ACS interviews monthly samples (U.S. Census Bureau, 2006a) to produce three period estimates: one based on one year of collected data, one based on three years, and one based on five years. The purpose of this paper is to highlight key issues of interpretation for data users. It contributes to the development of guidelines which will aid ACS data users in interpreting the ACS one-year, three-year, and five-year estimates, and in choosing which of these estimates is most appropriate for their data needs. The users we are targeting include both statistically unsophisticated users and sophisticated users who could benefit from an introduction to these new data products. This paper presents results of work in progress.

2. Background

2.1 The Decennial Census Long Form

The decennial census long form questionnaire was sent to a sample of households for every census since 1940. In 2000 approximately one in six households was in the long form sample. The long form contained all of the questions on the decennial census short form, as well as additional detailed questions relating to the social, economic, and housing characteristics of each individual and household (U.S. Census Bureau, 2002). Information derived from the long form is referred to as census sample data, and was tabulated for geographic entities as small as the block group level in the 1980, 1990, and 2000 census data products.

2.2 The American Community Survey

The ACS asks essentially the same questions as the Census 2000 long form, but there are some differences in resulting estimates because of differences in reference periods and in how the data are collected (U.S. Census Bureau, 2006b). The ACS provides more current data than the long form in between decennial census years, and it will also unencumber the decennial census of the long form operations. The ACS was ramped up to its full sample size starting in 2005. It provides full sets of estimates annually for all states and for all communities of 65,000 persons or more, based on the interviews from a full calendar year. For less populous communities, such as rural areas, city neighborhoods, or very small population groups, the sample size is too small to make reliable estimates from a single year of ACS sample. At about three million addresses per year, it will take five years to provide estimates of roughly comparable quality to those of the long form sample in Census 2000 for small geographic areas such as census tracts.

The ACS has been producing single-year estimates since 1997 for selected geographic areas. It will produce its first three-year estimates with a fully implemented sample in 2008 and its first five-year estimates in 2010, though three-year and five-year estimates for 34 test counties were released in 2007 as part of the Multi-Year Estimates Study (U.S. Census Bureau, 2007a). Three-year period estimates are based on data collected during the 36 months of the three most recent calendar years, and five-year period estimates are based on data collected during the 60 months of the five most recent calendar years. Each set of period estimates will be produced annually. The weighting for these multi-year estimates will be similar to that used to produce single-year estimates (Asiala & Tersine, 2007; U.S. Census Bureau, 2006a). The annual samples corresponding to the estimation period will be combined together and all the weighting steps will be performed similarly to the single-year weighting. The ACS population and housing unit estimates are controlled by county or groups of counties to the average of the Census Bureau's official estimates from the Population Estimates Program (U.S. Census Bureau, 2007b) over the individual years of the multi-year estimation period. Estimates based on five years of sample data will be published for all statistical, legal, and administrative entities, including census tracts, block groups, and small incorporated places such as cities and towns. Geographic entities with populations of at least 20,000 also receive three-year estimates (U.S. Census Bureau, 2006a).

---

[1]This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. Any views expressed on statistical, methodological, or technical issues are those of the authors and not necessarily those of the U.S. Census Bureau.

3. Statistical Issues and Issues of Interpretation for Multi-Year Data

The ACS has inspired much discussion inside and outside the Census Bureau on the interpretation and use of ACS data. Good examples of thinking about multi-year estimates coming from outside the Census Bureau include The Committee on National Statistics (2007) and Taeuber (2006, though this work makes reference to outdated MYE methodology). The crux of the current work is to draft guidelines to address the following issues and develop examples and case studies to illustrate them.

1. It is critical that users understand what the ACS multi-year estimates are. How do we explain that they are period estimates and what that means?
2. How can we describe in general terms for which kinds of applications we recommend single-year, three-year or five-year estimates? In particular, what key concepts can we convey to users to help guide them?
3. How do the variances of the estimates compare between the single-year, three-year and five-year estimates across geographic areas of differing sizes and across subpopulations?
4. What is the trade-off between currency and reliability of ACS estimates?
5. How cautious must users be when comparing multi-year estimates to single-year estimates, such as the single-year estimate which is at the ‘center’ of the multi-year period?
6. How do we explain to data users how to use multi-year estimates to track change over time and what can we say about the reliability of ACS estimates in measuring change over time?
7. What cautions do we give users about comparing multi-year estimates (MYEs) whose periods overlap?
8. When does the smoothing that results from MYEs reveal changes or trends that the noise or variance in a series of single-year estimates obscures?

4. Methods

Our first step is to determine what concepts about the multi-year estimates are most crucial for data users to understand. To accomplish this we consult Census Bureau and external expertise, including previous discussion and published documentation. As we establish what concepts we want to convey to data users, we develop examples and case studies to illustrate them.

To demonstrate and discuss the various relationships among the estimates for the different length periods, we will search for examples from among 34 counties in the Multi-Year Estimate Study test counties. These 34 counties are a subset of the 36 counties selected for the Census Bureau’s test phase of the ACS from 1999 to 2001 (U.S. Census Bureau, 2004). Of the 36 counties, two are not used in our study because they had a sampling rate of 1 percent from 1999 to 2001. Of the 34 in our study, five had a sampling rate of 3 percent and the rest had a sampling rate of 5 percent from 1999 to 2001. From 2002 to 2004 these 36 test counties were included in the ACS with a base sampling rate of 2.5%. In 2005 all counties were included in the fully implemented ACS with a base sampling rate of 2.3%.

5. Results: Some Draft Guidelines and Examples

In this section we start with a discussion of some key points. In Section 6 we consider change in estimates over time, a topic large enough that we devote to it a section of its own. Lastly, in Section 7 we summarize with guidelines on when and when not to use MYEs.

5.1 Multi-Year Estimation: Key Points

We have identified several key points that users should grasp when using MYEs and when deciding between the use of MYEs and single-year estimates.

- The ACS estimates are period estimates.
- What are the relative precisions of the single-, three-, and five-year estimates?
- What is the precision of estimates of subpopulations?
- What is the trade-off between the currency and precision of estimates?
- An MYE is not an estimate of its center year.
- Make comparisons between areas over the same time periods.
- ACS estimates are controlled to Population Estimates from the Population Estimates Program.

More detailed discussion of these points follows.

5.2 Period Estimates

The first key concept users must grasp is that of a period estimate. Users should interpret the ACS estimates as an average over the collection period. Contrast this with the decennial census, which is construed to be a snapshot of April 1 of the census year. Hence the ACS single-year estimate for 2000 and the Census 2000 estimate do not measure the same time frame. Taeuber (2006) puts it well: “The single-year estimate is NOT an estimate of an implied beginning, mid-year (such as July), or end-of-year characteristic”. Conceptually, a multi-year period estimate is merely an extension of a single-year estimate. Data are collected and combined for 36 or 60 months. They are controlled to an average of annual Population Estimates over the time period. As a consequence, MYEs are not an average of single-year estimates and thus not moving averages, although they share some characteristics of moving averages.

5.3 Relative Precision of the Single-, Three-, and Five-Year Estimates for Totals

We measure the precision of an estimate by either the standard error (SE) or the coefficient of variation (CV), which is the SE divided by the estimate. Theoretically, for uncontrolled estimates the SE is a function of the sample size. This means that in many cases we can give an approximate relationship for the SE or CV of single-, three-, and five-year estimates of totals of persons, households, or housing units with certain characteristics. The SE's and the CV's of the three-year estimates are about one over the square root of three, or about 58%, of the single-year estimates; and the five-year estimates are about one over the square root of five, or about 45%, of the single-year estimates. Consider Table 1 for an illustration of how SEs decrease as the period lengthens. The SEs of the three-year estimates range from about 54% to 69% of the single-year estimates. For example, the SE for the three-year estimate for Householder, 414, is 54.3% of the single-year estimate, 762. The SEs of the five-year estimates range from about 34% to 56% of the single-year estimates. The observed three-year and five-year SE's in this example differ from the predicted 45% and 58% of the single-year SE's due largely to sampling variation.

While this relationship holds approximately for estimates of totals, it doesn't hold up as well for estimates of proportions or averages which involve estimates in both the numerator and the denominator. In Table 2 we see another example of how SE's shrink with the MYEs, but in this case the estimates are of percentages. For example, the SE of the 2000-2004 estimate of the proportion of families in poverty is 0.8%, compared with 2.3% for the 2004 estimate.

5.4 Precision of Estimates for Subpopulations

The standard error of an estimate depends on the sample size upon which it is based. An estimate can be for a larger area such as a county, yet if it applies to a smaller subpopulation it is the size of the subpopulation that determines how large the sample is for that estimate and thus its standard error. For example, consider Sevier County Tennessee, which had an estimated population of 76,632 in 2004 according to the Population Estimates Program. This total is larger than the Census Bureau's 65,000 cutoff for publishing single-year estimates for geographic areas. However, some subpopulations will be much smaller than 65,000. In Table 2 we see that the number of families with a female householder, no husband, with related children less than 18 years, has an estimate of only 1,883 based on the 2000-2004 MYE. (Note that this total is for reference - we could have used the 2004 or 2002-2004 estimated totals equally well). Not surprisingly, the SE for the 2004 single-year estimate of the poverty rate for this subpopulation is large, 13%. For such small subpopulations users obtain much more precision using the three-year or five-year estimate. In this example the five-year estimate has a SE of 4.9%, and the three-year estimate has a SE of 6.8%. In short, *MYEs are typically preferable to single-year estimates for examining estimates based on small subpopulations.*

Table 1: Relationship - Comparisons of Standard Errors for Blackhawk County

Relationship to Householder	2000-2004 Total	2000-2004 SE	2000-2004 Percent of 2004 SE	2002-2004 SE	2002-2004 Percent of 2004 SE	2004 SE
Householder	51,457	263	34.5	414	54.3	762
Spouse	25,305	320	45.5	405	57.6	703
Child	31,751	239	36.4	409	62.3	657
Other relatives	3,827	282	56.1	349	69.4	503

Table 2: Percent Poverty by Family Type for Sevier County

	2000-2004	2000-2004		2002-2004		2004	
	Total Family Types	Pct. in Poverty	SE	Pct. in Poverty	SE	Pct. in Poverty	SE
All families	21,881	9.5	0.8	9.7	1.2	10.0	2.3
With related children under 18 years	9,067	15.3	1.5	16.5	2.4	17.8	4.5
Married couple families	17,320	5.8	0.7	5.4	0.9	7.9	2.0
With related children under 18 years	6,633	7.7	1.2	7.3	1.7	12.1	3.9
Families with female householder, no husband	3,433	27.2	3.0	26.7	4.8	19.0	7.2
With related children under 18 years	1,883	40.2	4.9	40.4	6.8	38.3	13.0

We can also view the choice between single-year, three-year, and five-year estimates graphically in Figure 1 (at the end of the paper), which plots the three estimates over time for families with a female householder, no husband, with related children less than 18 years old. The year on the horizontal axis is the last year of the estimation period. That is, 2005 refers to the single-year estimate for 2005, to the three-year estimate for 2003-2005, and to the five-year estimate 2001-2005. The dashed lines are upper and lower 90% confidence intervals. The three-year and five-year estimates both look acceptable. In this example the five-year estimates give only a slightly narrower confidence interval than the three-year.

5.5 Currency Versus Precision

The key trade-off between single-year estimates and MYEs is between their currency and precision: *MYEs yield smaller CV's but use less current data.* In general, data users want to use a shorter period estimate as it uses data more relevant to what is happening currently. However, if that estimate is not precise enough to answer the question the user is addressing, currency must be traded for the additional precision of a multi-year estimate.

If a single-year estimate yields adequate precision it is usually preferable to a MYE because it is more up-to-date. Table 3 illustrates how the most current five-year MYE can differ from the most current single-year estimate. It shows the percentage of households where Spanish is spoken at home for the test counties Broward, FL, and Lake, IL. The differences between the 2004 and 2000-2004 estimates are not small at 1.4% and 1.5%, and they are clearly larger than the SEs of the 2004 estimates of 0.2% each. Here the trade-off of gaining precision at the expense of currency is not worth it.

Table 3: Percent Spanish Language Spoken at Home

County	2004	SE of 2004	2000-2004	Difference	SE of Difference
Broward	19.9	0.2	18.5	1.4	0.2
Lake	15.9	0.2	14.4	1.5	0.3

We see how the lack of currency can be quite apparent when there is a strong linear trend over time in Table 4. In the first row, we see percent Spanish spoken at home as measured by single-year estimates increasing from 13.1% in 2000 to 16.8% in 2005. In the second row we see how the four three-year estimates lag in revealing the increase. Not unexpectedly, the three five-year estimates lag even further. For example, consider the three estimates whose last estimation year is 2005; the single-year estimate is at 16.8%, while the three-year estimate lags about a year behind at 15.9%, and the five-year about two years behind at 15.1%. (Note that the differences between the single-year, three-year, and five-year estimates are statistically significant, with the one exception of the comparison between the 2002 estimate and the 2000-2002 estimate). We see the lag clearly in Figure 2 (at the end of the paper) for both the three- and five-year estimates. For this data we prefer the single-year data for its greater currency.

5.6 A Multi-Year Estimate is not an Estimate of its Center Year

Users may be tempted to view the MYE as being 'centered' at the middle year of the period in the MYE, that is, as an estimate of that middle year. But clearly, an MYE is not an estimate for any single year. In Table 5 we compare the single-year estimate for 2002 versus the 2000-2004 MYE for Percent Spanish Language spoken at home in Tulare County, CA. We see that the percent who speak Spanish at home for 2002 is 2.8% higher than for 2000-2004, no small difference. In fact, it is the pattern in change of the estimates across years that determines if the MYE is close to the estimate for the middle year of the period.

Table 5: Percent Spanish Language Spoken at Home

County	2002	2000-2004	Difference in Pct.	SE of Difference
Tulare	43.3	40.5	2.8	0.8

5.7 Make Comparisons between Areas over the Same Time Periods

When comparing estimates across geographies or subpopulations, use the same period for each estimate. For example, say you wish to compare the percent Spanish speakers at home (for population 5 and older) between a

Table 4: Percent of Population 5 Years and Older who Speak Spanish at Home with 90% Confidence Intervals - Lake County, IL

Single-Year Estimate	2000 13.1 (0.5)	2001 13.6 (0.4)	2002 13.7 (0.5)	2003 15.1 (0.6)	2004 15.9 (0.4)	2005 16.8 (0.5)
Three-Year Estimate			2000-2002 13.4 (0.3)	2001-2003 14.1 (0.3)	2002-2004 14.9 (0.3)	2003-2005 15.9 (0.3)
Five-Year Estimate				1999-2003 13.7 (0.2)	2000-2004 14.3 (0.2)	2001-2005 15.1 (0.3)

suburban area, Lake County IL, and a rural area, Upson County GA. (In a more realistic example you might want to pick neighboring suburban and rural counties, but the Multi-Year Estimates Study has only 34 counties to choose from). The most recent Lake County published estimates are for the periods 2001-2005, 2003-2005, and 2005, whereas Upson county has only 2001-2005 estimates available. The correct comparison is Lake County's five-year estimates with Upson's five-year estimates: 15.1% versus 1.4%. Do not compare Lake County's single-year estimate for 2005, 16.8%, with Upson County's five-year estimate.

5.8 Controlling and Some Operational Considerations

The ACS controls total housing unit (HU) and person weights to conform with estimates from the Census Bureau's Population Estimates Program. Controlling estimates reduces the variability of the ACS HU and person estimates, and reduces bias due to undercoverage of HUs and people within housing relative to the Population Estimates. This controlling is done by weighting area, which is usually a county but can be two or more counties when a smaller county is grouped with others (though in the Multi-Year Estimates Study all controlling was done at the level of the individual county).

If there is enough sample in a weighting area, ACS controls estimates by 156 combinations of sex, age, race, and Hispanic origin. However, for most weighting areas the 156 combinations are collapsed into a smaller number of combinations which are controlled exactly.

Exactly controlled estimates are assumed to have no standard error at the geographic level to which they are controlled, which is typically the county level. However, sex, age, race and Hispanic origin estimates may have modest standard errors if the published age groupings are not the same as the age groupings that are exactly controlled. At higher levels of aggregation such as states, the CVs of the estimates of these demographic variables will likewise be small. Note though that for these estimates we would never recommend using the ACS. Users should obtain basic demographic estimates from the Population Estimates Program whenever possible.

For the estimates of sex, age, race, Hispanic origin, and number of housing units, at the county or state level the MYEs offer little or no advantage in obtaining smaller standard errors. Table 6 illustrates this point. For Rockland County, SE's of the age and sex categories are very small for both the single-year estimate in 2004 and the five-year estimate 2000-2004. They are not exactly zero because the published age groupings are not the same as the age groupings that are exactly controlled. Notice that the total population for Rockland county was estimated at 283,202 from the average of the 2000-2004 Population Estimates, and at 285,830 from the 2004 Population Estimates.

Table 6: Rockland County Demographics with SEs

	2004	2000-2004	2004	2000-2004
	Percent		SE	
Male	49.4	49.0	0.2	0.1
Female	50.6	51.0	0.2	0.1
Under 5 years	7.7	7.6	0.1	0.1
5 to 9 years	7.4	7.8	0.3	0.1
10 to 14 years	8.0	7.9	0.3	0.1
15 to 19 years	7.0	7.0	0.2	0.1
20 to 24 years	6.3	5.8	0.2	0.1
25 to 34 years	11.0	11.6	0.3	0.1

Estimates strongly correlated with controlled variables also have lower SEs and CVs at the level of control. Consider the estimates for occupied housing units, which are highly correlated with housing unit counts, and the number of renter-occupied HUs, which is less strongly correlated. See the estimates in Table 7. The estimated number of housing units in the Bronx in 2005 is 502,211, which comes from the Population Estimates. The estimate for the number of occupied HUs, 468,210, has only a small SE of 1,774, or a CV of 0.4%. The estimate for the number of renter-occupied HUs, 369,974, has a SE of 2,950 for a CV of 0.8%. Though this CV is larger than 0.4%, it is still modest.

Table 7: 2005 Housing Unit Estimates - Bronx County

	Total	SE	Pct.	SE
Occupied HUs	468,210	1,774	n/a	n/a
Owner-occupied	98,236	2,403	21	0.5
Renter-occupied	369,974	2,950	79	0.5

In short, because the ACS controls its estimates of totals of housing units and totals of persons with certain demographic characteristics, it is not valuable for estimating those very totals - data users should be referred to the Population Estimates. On the other hand, the ACS is most valuable for estimating proportions or averages of persons, households, or housing units with those characteristics that are not controlled.

In addition to controlling, there are two operational considerations that users need to be made aware of. First, for tabulation areas whose boundaries can change from year-to-year, the legal boundaries used to determine the housing units and persons within them are those reported as of April of the most recent year in the estimation period. Second, because of inflation, the cost of living may rise, fall, or stay the same during the years. However, we want the dollar amounts reported throughout the months of an estimation period to be treated as if they were reported in the same month. Thus inflation factors are used to adjust dollar amounts reported for all months in the estimation period to December of the last estimation year. For more information on inflation adjustments see of Census Bureau (2005).

6. Change Over Time

When considering change over time, an important distinction is whether the time periods being compared overlap or not. Analyzing change by examining estimates of non-overlapping time periods is both mathematically simpler and more straightforward to interpret, and thus recommended to users. However, there may be circumstances when overlapping time periods are worth examining. We'll divide the discussion along these lines.

6.1 Comparing Non-Overlapping Estimates

Since estimates for non-overlapping years are reasonably independent, a very good approximation to the variance for a difference between non-overlapping estimates is just the sum of the variances of the two estimates. (Because of the way ACS selects its sample, there can be a small correlation between estimates of non-overlapping years.) If X_1 and X_2 are two non-overlapping MYEs, or any two single-year estimates, then a close approximation to the standard error of the difference between X_1 and X_2 is given as follows:

$$SE(X_1 - X_2) = \sqrt{SE(X_1)^2 + SE(X_2)^2}$$

For example, compare the non-overlapping three-year estimates for poverty among female-headed households with children younger than 18 in Multnomah County from 1999-2001 and from 2002-2004: 31.2% with a SE of 1.2%, versus 35.2% with a SE of 1.8%. These estimates are displayed in Figure 3 at the end of the paper. The difference is 4.0% and the standard error of the difference obtained by the formula above is 2.2%.

6.2 Precision of Estimates of Change over Time

When changes over time can be analyzed with sufficient precision with a series of single-year estimates, then a user may have no reason to consider MYEs. *However, if the differences in a series of single-year estimates are large but not statistically significant, it suggests comparing differences between non-overlapping MYEs which have smaller SE's*. In Figure 3 the year-to-year variations we see are generally not significant, the one exception being the change between 2003 and 2004. For a less variable view of change over time we can consider non-overlapping three-year or five-year estimates, such as 2000-2002 versus 2003-2005.

6.3 Comparing Overlapping Estimates

The estimates of differences between overlapping MYEs suffer from difficulty in interpretability. Users must be advised to be cautious when examining overlapping MYEs, as *the difference between overlapping MYEs is driven by the difference between the non-overlapping years.*

To illustrate this point we can approximate the differences between overlapping MYEs by assuming that a MYE is equal to the average of the single-year estimates in its period (The Committee on National Statistics, 2007). For example, consider two overlapping five-year estimates, M_1 and M_2, that are averages of years one through five, Y_1, Y_2, Y_3, Y_4, Y_5, and years two through six Y_2, Y_3, Y_4, Y_5, Y_6, respectively. Then we have the following approximations, $M_1 = (Y_1 + Y_2 + Y_3 + Y_4 + Y_5)/5$, and $M_2 = (Y_2 + Y_3 + Y_4 + Y_5 + Y_6)/5$, which lead to $M_1 - M_2 = (Y_1 - Y_6)/5$.[2]

Data users who understand that the MYEs are period estimates will recognize that the differences between overlapping MYEs are determined by the nonoverlapping years and will likely not have use for such a comparison. On the other hand, it would be easy for a more naive data user to come to incorrect conclusions when directly comparing these estimates. They might interpret the difference between consecutive MYEs as the difference between the most recent years in the estimation periods, or the middle years of the estimation periods. The following simple example with artificial data in Table 8 illustrates how such comparisons could be misleading.

Table 8 - Percent Poverty in Artificial County

Year	2005	2006	2007	2008
Estimate in Percent	11	17	17	14

Consider the two three-year MYEs from 2005-2007 and 2006-2008. The estimate for 2005-2007 is 15% and for 2005-2007 is 16%. If one viewed the difference as a reflection of the change in the most recent years, 2007 to 2008, one would conclude incorrectly that the poverty rate had increased by 1% in that one-year period, though we can see that the poverty rate declined by 3% from 2007 to 2008. Similarly, if one viewed the difference between the MYEs as that between the middle years of the MYE, 2006 and 2007, one would conclude they had increased by 1% when they remained the same.

6.4 Smoothing

Because of the complexities of interpretation as discussed above, we discourage direct comparisons between estimates for overlapping time periods. However, plots of a series of overlapping periods can be useful to smooth out short-term fluctuations that can obscure longer-term trends or cycles.

[2] Note that approximations to the standard errors of the differences between overlapping MYEs can also be obtained from these forms and are discussed in the Multi-Year Estimate Study's Accuracy Statement (U.S. Census Bureau, 2007a) and by The Committee on National Statistics (2007).

This is because a series of MYEs mathematically resembles a series of simple moving averages. Figure 1 and Figure 3 both present good examples of the smoothing effects of MYEs. In both graphs we see that the change in the single-year estimates from year-to-year is generally dominated by sampling error and we notice smoothing in the three-year estimates. Considering Figure 3, the only year-to-year change that is statistically significant is the jump from 2003 to 2004; we also see the lag in the MYEs as the jump from 2003 to 2004 is spread over several years. This example summarizes the effects of the smoothing of the MYEs: sampling variation is suppressed but real changes may be drawn out over time, i.e., seen with lag.

7. Summary: When and When not to Use Multi-Year Estimates

When to Use Multi-Year Estimates

- For tracts and other smaller geographies - single-year estimates are not available.
- To obtain estimates with lower standard errors.
- For smaller subpopulations of larger geographies.
- For more precise comparisons of change over time (non-overlapping comparisons).
- For smoothing data over time.

When to Use Single-Year Estimates

- For larger geographies and populations - prefer more current single-year estimates.
- For counties and states for age, sex, race, Hispanic origin, or housing units, where the standard errors are already small due to controlling.

8. Future Research

As this paper represents an early stage in the development of users' guidelines, much work remains to be done. Several topics mentioned early in the paper have not been well-developed, such as the benefits and pitfalls of smoothing. Furthermore, we expect new research directions will present themselves as we converse with ACS researchers and data users and as we explore the Multi-Year Estimates Study in more depth.

References

Asiala, M., & Tersine, A. (2007). "Methodology for the Production of American Community Survey Multiyear Estimates". *Proceedings of the Survey Research Methods Section*. American Statistical Association.

Committee on National Statistics (2007). "Chapter 6: Weighting and Interpreting ACS Multiyear Estimates." *Using the American Community Survey: Benefits and Challenges.* National Academies Press.

Taeuber, C. M. (2006). "Chapter 9: Multi-year estimates." *American Community Survey for Community Planning.* Trafford Publishing.

U.S. Census Bureau (2002). "Census 2000 Basics." http://www.census.gov/mso/www/c2000basics/00Basics.pdf

U.S. Census Bureau (2004). "Meeting 21st Century Demographic Data Needs - Implementing the American Community Survey: Report #8: Comparison of the American Community Survey Three-Year Averages and the Census Sample for a Sample of County and Tracts." http://www.census.gov/acs/www/AdvMeth/acs_census/creports/Report08.pdf

U.S. Census Bureau (2005). www.census.gov/2005pubs/acs_01.pdf

U.S. Census Bureau (2006a). "Design and Methodology: American Community Survey." *Technical Paper 67*. Issued May 2006; http://www.census.gov/acs/www/Downloads/tp67.pdf

U.S. Census Bureau (2006b). "2006 Data Users Handbook The American Community Survey" http://www.census.gov/acs/www/Downloads/Handbook2006.pdf

U.S. Census Bureau (2007a). Multi-Year Estimates Study, "Accuracy of the Data". http://www.census.gov/acs/www/Downloads/Accuracy_of_the_Data_MYE.pdf

U.S. Census Bureau (2007b): Census Bureau Website on Population Estimates. http://www.census.gov/popest/estimates.php

Figure 1: Percent Poverty for Families with Female Householder with Related Children under 18 Years - Sevier County, TN

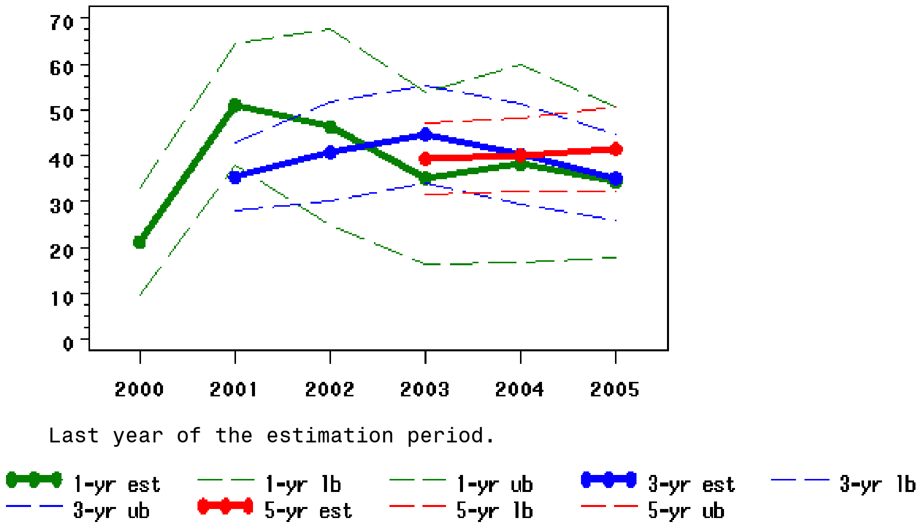

Figure 2: Percent Spanish Speakers at Home for Population Five Years and Older - Lake County, IL

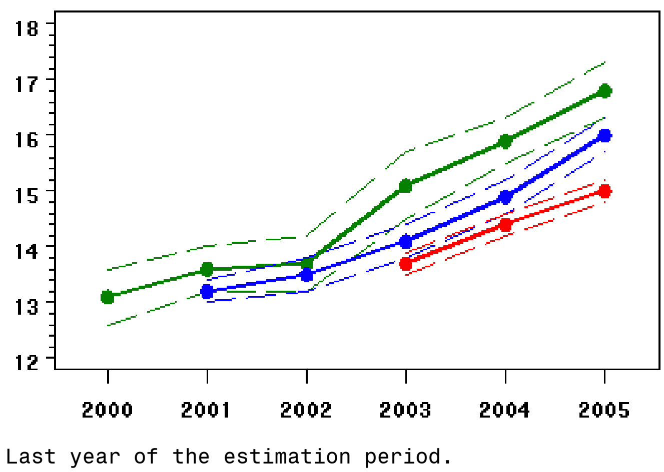

Figure 3: Percent Poverty for Families with Female Householder with Children under 18 - Multnomah County, OR