American Community Survey Technical Training

Mark E Asiala

CaSDC General Update Meeting

June 27, 2013

United States Census Bureau | U.S. Department of Commerce Economics and Statistics Administration U.S. CENSUS BUREAU

Overview

- Sample Design
- Sample Disposition
- Weighting and Controls
- Migration Flow Data

United States Census Bureau | U.S. Department of Commerce Economics and Statistics Administration U.S. CENSUS BUREAU

SAMPLE DESIGN

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Starting Points of Sample Design

- We have a fixed budget to design an annual survey to satisfy the needs of decennial long form
- Driven by reliability parameter called coefficient of variation which measures variability compared to size of estimate.
- Target is the 5-year estimates
- 1- and 3-year estimates are by-products

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Goals of Sample Design

- Produce reliable estimates for:
  - Small areas including census tracts, governmental units
  - Small populations as a by-product
- Reduce the disparity in reliability across size of area
- Reduce response burden on the public

Response Burden

- Early in the history of the ACS, there was concern about the burden on the public
- Thus, it is built into the sample design that an address is only eligible to be in sample once in a 5-year period

Ensuring Reliability for Small Areas

- Important concept:
  - The reliability of an estimate is based on its sample size not its sampling rate
- Thus, large area can be sampled at a lower rate than smaller areas to get the same level of reliability
- This allows us to use different sampling rates to improve reliability for small areas

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

History of Varying sampling rates

- 1980 Census had 2 sampling rates
- 1990 Census had 3 sampling rates
- 2000 Census had 4 sampling rates
- 2005-2010 ACS had 7 sampling rates
- 2011+ ACS has 16 sampling rates

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Why So Many Rates?

- More rate categories allows greater fine tuning of the sample
  - Less disparity in reliability across size classes
  - Less sudden jumps for areas near the boundaries of the size classes
- However, there is a trade-off
  - Improves reliability for target areas
  - May decrease reliability in higher geo areas
- Optimum is a question of balance

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

How are our rates defined?

- Items to note:
  - Total sample size is fixed not sampling rate
  - Sampling rates for smallest areas are fixed
  - Remainder are parameterized as a function of our base rate (BR)
  - Rates are dependent on measure of size (MOS) for the area and response rate
  - Sampling rate for a census block is based on smallest governmental unit or tract that contains it

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Sampling Entities

- Governmental Units
  - Counties
  - Minor Civil Divsions
  - Places
  - School Districts
  - American Indian Areas including Chapters
- Tracts

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Sampling Rates for Blocks based on their Governmental Units Measure of Size (Gov't Unit MOS)

STRATUM	BLOCK MOS CRITERIA	Sampling Rates
1	0 < Gov't Unit MOS ≤ 200	15% (fixed)
2	200 < Gov't Unit MOS ≤ 400	10% (fixed)
3	400 < Gov't Unit MOS ≤ 800	7% (fixed)
4	800 < Gov't Unit MOS ≤ 1,200	2.8 × Base Rate

- Measure of size (MOS) is defined as estimated occupied housing units for area
- Fixed rates for strata 1-3, only stratum 4 has a parameterized sampling rate
- If Gov't Unit MOS > 1,200 use next slide

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Sampling Rates for Blocks based on their Tract Measure of Size (Tract MOS)

Stratum	Block MOS Criteria	Sampling Rates
5	0 < Tract MOS ≤ 400	3.5×Base Rate
6	0 < Tract MOS ≤ 400 High Resp.	0.92×3.5×Base Rate
7	400 < Tract MOS ≤ 1,000	2.8×Base Rate
8	400 < Tract MOS ≤ 1,000 High Resp.	0.92×2.8×Base Rate
9	1,000 < Tract MOS ≤ 2,000	1.7×Base Rate
10	1,000 < Tract MOS ≤ 2,000 High Resp.	0.92×1.7×Base Rate
11	2,000 < Tract MOS ≤ 4,000	Base Rate
12	2,000 < Tract MOS ≤ 4,000 High Resp.	0.92×Base Rate
13	4,000 < Tract MOS ≤ 6,000	0.6×Base Rate
14	4,000 < Tract MOS ≤ 6,000 High Resp.	0.92×0.6×Base Rate
15	6,000 < Tract MOS	0.35×Base Rate
16	6,000 < Tract MOS High Resp.	0.92×0.35×Base Rate

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Simulated Reliability of Tract-Level Estimates by Size Class

Tract Size Category	Average Tract Size	CV* Using 7 Rates	CV* Using 16 Rates
0 – 400	291	59%	35%
401 – 1,000	766	36%	25%
1,001 – 2,000	1,485	26%	25%
2,000 – 4,000	2,636	23%	25%
4,000 – 6,000	4,684	17%	25%
6,000 +	8,337	13%	25%

CV = coefficient of variation (standard error / estimate) for simulated 10% poverty estimate

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Final Comments on Sampling

- The addition of more summary rates allows us to achieve more equitable reliability across small areas
- The impact on the reliability of larger areas has been minimal
- The combination of increasing the number of sampling rates and the sample expansion in 2011 should help small area data substantially

SAMPLE DISPOSITION

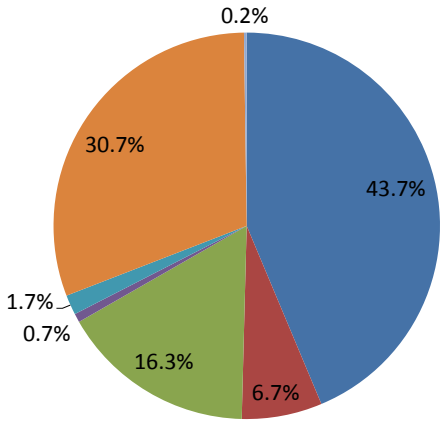
What is Sample Disposition?

- What happens to our sample once it is sent to the field?
- Modes of data collection
  - Internet (2013+)
  - Mail
  - Computer Assisted Telephone Interview
  - Computer Assisted Personal Interview

Classifications for Sample Disposition (2011 Data)

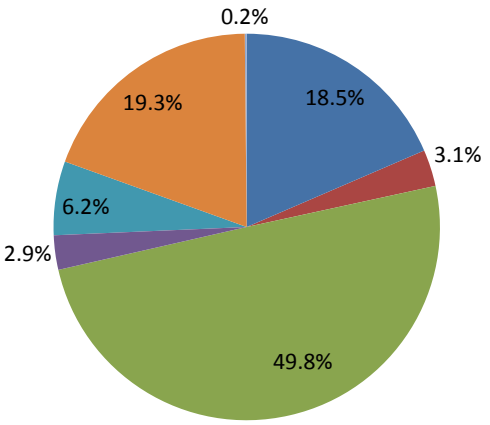
- Interviews
  - Mail Interview
  - CATI Interview
  - CAPI Interview
- Noninterviews
  - CAPI Non-Interview
  - Other Nonrespondents
- Other
  - CAPI Delete
  - Sampled Out for CAPI

Sample Disposition for U.S.



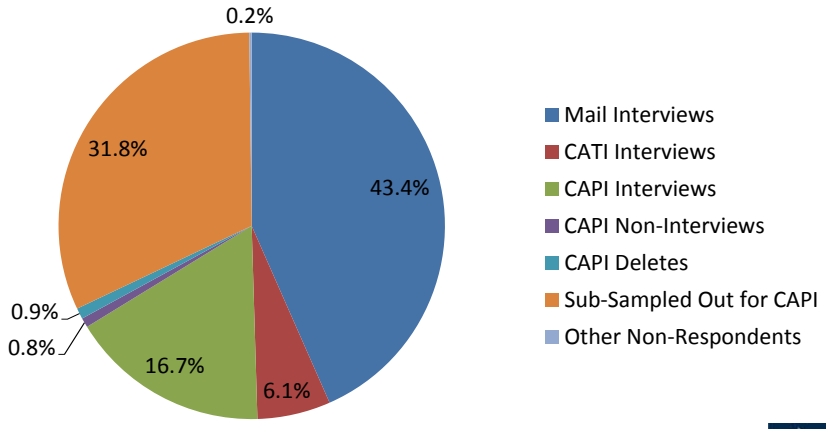
United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Sample Disposition for Alaska



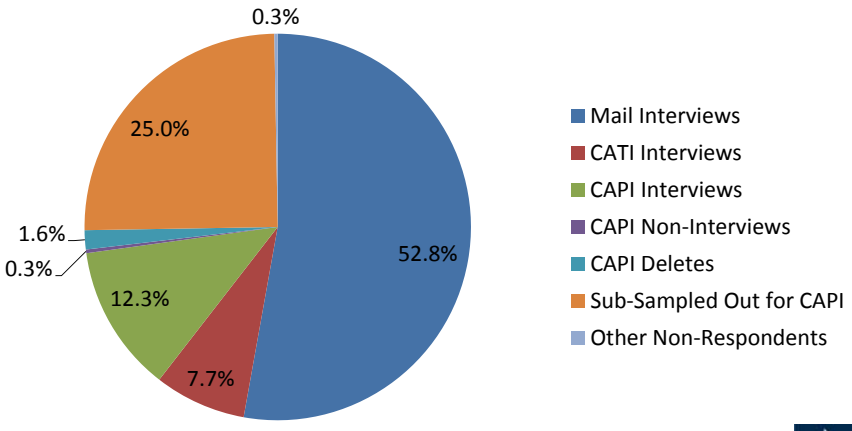
United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Sample Disposition for California



United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Sample Disposition for Minnesota



United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

WEIGHTING AND CONTROLS

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Purpose of Weighting

- We sample only a portion of universe of housing and population
- Without weights, estimates from the sample would represent only the interviewed sample
- Process of weighting allow estimates to reflect the original universe of housing units and population

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Starting Points for Weighting

- Unique housing unit weight is assigned to every sample housing unit to estimate
  - Housing characteristics
  - Household characteristics
- Unique person weight is assigned to each person to estimate
  - Householder characteristics
  - Population characteristics

Focus for Today

- General overview of housing unit and household person weighting
- Role of independent estimates of housing units and population by demographics as survey controls

Basic HU Weighting Summary

- Assign base weights account for probability of selection
- Adjust for nonresponse
- Adjust for total housing unit coverage

  ...go off and do household person weighting…

- Adjust for differential coverage of housing units based on demographics of householder

Base Weights

- Two sample selections occur for the ACS
- Initial sample selection
  - Affects all sample records
  - Rates vary from 0.5% to 15%
- Sample selection of nonrespondents for personal visit (CAPI)
  - Affects only housing units that do not respond to prior to personal visit
  - Rates vary from 1-in-3 to full followup (100%)

Examples: Base Weights

- Weights are the inverse of the sampling rates
  - Sampling rate = 5%, weight is 1/0.05 = 20
  - Sampling rate = 10%, weight is 1/0.10 = 10
- If a unit does not respond via mail, internet, or telephone, it may be sampled further before being selected for personal visit (CAPI)
  - CAPI sampling rate is 1-in-3, then the weight above is multiplied by 3

Adjustment for Nonresponse

- Key assumptions of nonresponse adjustment
  - All vacant units are properly identified in the field
  - All noninterviews are assumed to be occupied
- Based on these assumptions, the nonresponse adjustment
  - Adjusts the weights of the occupied interviews to account for the noninterviews
  - Does not adjust the weights of vacant interviews
  - Weights of noninterviews are set to zero

Examples: Adjust for Nonresponse

- Consider the following:
  - Weighted occupied interviews = 81
  - Weighted noninterviews = 9
  - Weighted vacant interviews = 10
- After adjustment [factor occ. int.= (81+9)/81]
  - Weighted occupied interviews = 90
  - Weighted noninterviews = 0
  - Weighted vacant interviews = 10
- Note weighted vacant interviews is fixed

Adjustment for HU Coverage

- The adjustment for coverage uses independent estimates of housing units (HUs)
  - Independent estimate is for total HUs only
  - No breakdown of occupied / vacant is available
- Thus, this adjustment has the following impact
  - Estimate of occupied and vacant HUs are impacted proportionally
  - Vacancy rate for HUs is not impacted

Example: Coverage Adjustment

- Consider the following:
  - Weighted occupied interviews = 90
  - Weighted vacant interviews = 10
  - Total weighted HUs = 100, Independent Est = 110
- After adjustment (factor = 110 / 100 = 1.1)
  - Weighted occupied interviews = 99
  - Weighted vacant interviews = 11
  - Total weighted HUs = 110 = independent estimate
- Note that the vacancy rate:
  start 10/100 = finish 11 / 110 = 90%

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Household Person Weighting

- Initial person weight is the housing unit weight after the HU coverage adjustment
- Already incorporated
  - Adjusting nonresponse
  - Adjusting for whole household / HU coverage
- What remains?
  - Within household coverage
  - Differential coverage by demographics

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Goals of Person Weighting (Iterative Process)

- Adjust for subcounty total population coverage
- Ensure consistency between person and housing unit weights when estimating
  - Occupied housing units and householders
  - Married-spouse-present households and estimates spouse (also unmarried partners)
- Adjust for differential coverage by demographics

Subcounty Coverage

- Subcounty area (cannot cross county)
- Area must have the following population
  - 24,000 for 1-year ACS
  - 8,000 for 3-year ACS
  - 2,500 for 5-year ACS
- Collapse areas as necessary
- Must have 2x population above for controlling subcounty areas to be possible
- Entire county is the fall back method

Spouse / Householder Equalization

- Adjust person weights so that the following hold true:
  - Make estimated householders equal to estimated occupied housing units
  - Make estimated spouses + unmarried partners equal to households of same type
  - Preserve total population
- Without this step, estimates made with HU weights vs person weights would be inconsistent

Differential Person Coverage

- These adjustment are performed within a weighting area (1 or more counties)
- Adjust for coverage at weighting area by
  - Hispanic + Non-Hispanic by 5 Race (6 total)
  - Age / Sex (13 x 2 = 26 categories)
- Collapse categories as necessary
  - Maximum is 156 combinations of above
  - Realistically, collapse to approximately half

Iterative Process

- We can't achieve each of the 3 goals simultaneously
- We iterate the three steps up to 40 times
- Criteria for stopping
  - Achieve goals within 0.01% in fewer than 20 iterations (e.g., +/- 1 for subcounty pop = 10k)
  - Achieve goals within 0.1% in fewer than 40 iterations (e.g., +/- 10 for subcounty pop = 10k)
  - Reach 40 iterations

Adjustment for Differential Householder Coverage

- Applied only to occupied HUs
- Total occupied housing units
  - Changes very little at county level
  - Can change more at the subcounty level
- Total vacant housing units
  - Unchanged at any geographic level
- Vacancy rate
  - Impacted by any change in estimated occupied
  - Impacted subcounty but very little at county level

Example: Differential Coverage Adjustment

- Consider the following area total:
  - Estimated HUs with White Householder = 55
  - Estimated HUs with non-White householder = 44
  - Estimated vacant HUs = 11, Est. total HUs = 110
- After adjustment
  - Estimated HUs with White Householder = 53
  - Estimated HUs with non-White householder = 47
  - Estimated vacant HUs = 11, Est. total HUs = 111
- Note: estimated vacant HUs is unchanged
- Note: est. vacancy rate changes because total +1

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

In summary

- Weighting assigns person and HU weights
- Weighting accounts for sampling, nonresponse, and coverage adjustments
- Use population estimates as survey controls
- Some subcounty areas (places / minor civil divisions) may be (nearly) controlled
- Published counties typically are controlled for
  - Total population
  - Possibly Hispanic / non-Hispanic, some age / sex categories
- Do not expect county race totals to match population estimates

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

MIGRATION FLOW DATA

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

County-to-County Migration Flows

- Derived from residence one year ago question on ACS
- In-flow estimate would list estimated population coming from all 3,142 other counties to the county of interest
- Out-flow would be the reverse of that
- Poses significant challenges to standard American Fact Finder system

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Release of Migration Flow Data

– Data are released as downloadable tables

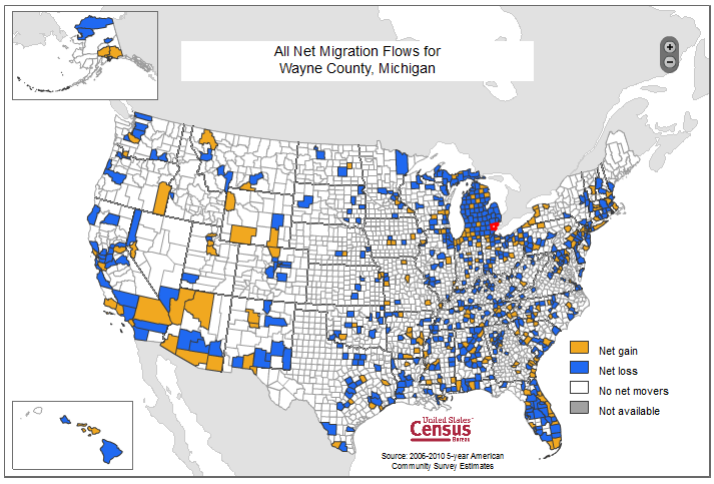
http://www.census.gov/hhes/migration/data/acs/county-to-county.html

– Data are also available on an interactive mapping tool

http://flowsmapper.geo.census.gov/flowsmapper/flowsmapper.html

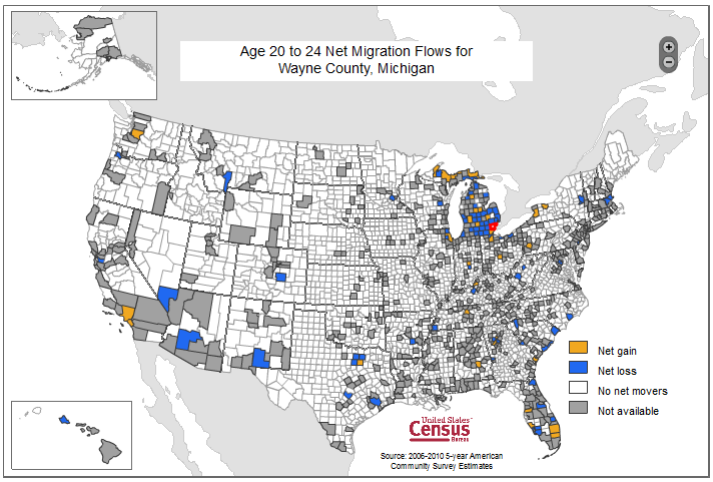
United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Wayne County, MI – Net Flow



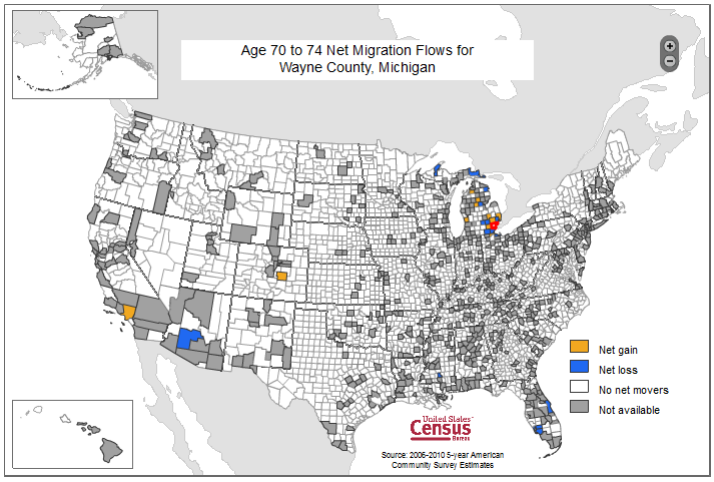
United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU

Wayne County, MI – Net Age 20-24



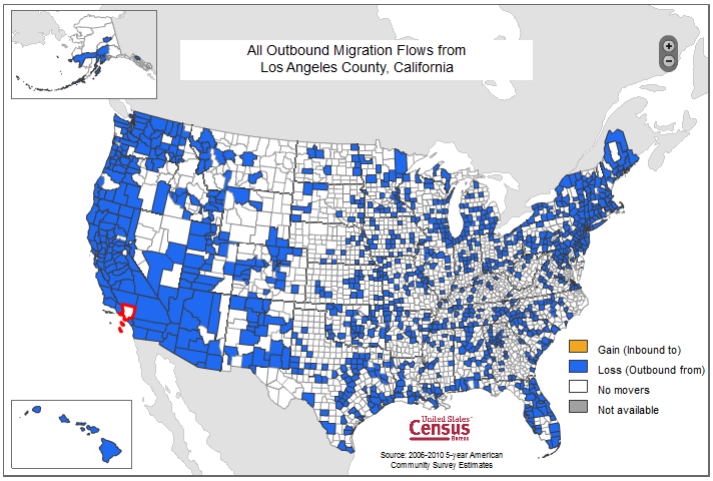
United States Census Bureau | U.S. Department of Commerce
U.S. CENSUS BUREAU

Wayne County, MI – Net Age 70-74



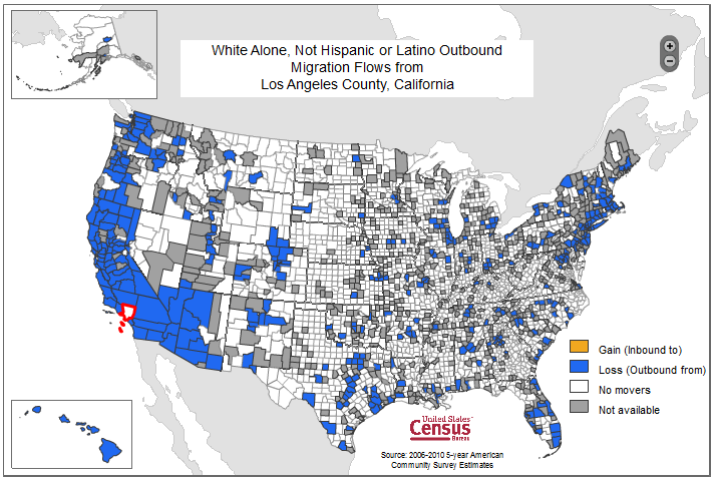
United States Census Bureau | U.S. Department of Commerce
U.S. CENSUS BUREAU

Los Angeles - Outflow



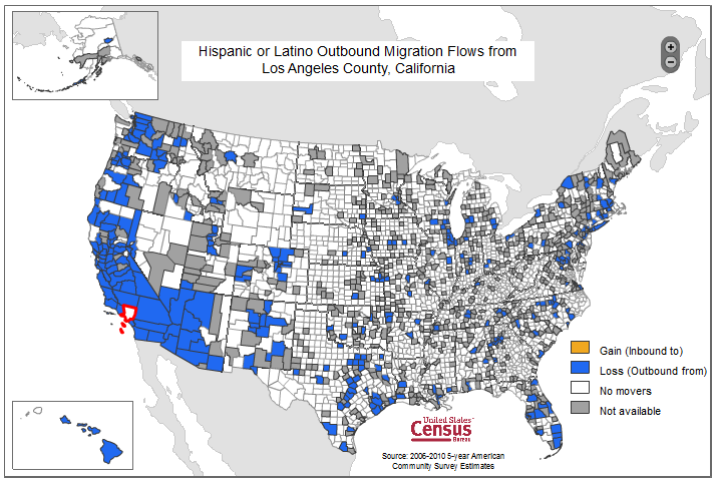
United States Census Bureau | U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU

Los Angeles – Outflow White Alone, Not Hispanic



United States Census Bureau | U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU

Los Angeles – Outflow Hispanic



United States Census Bureau | U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU

What to Expect

Year	2012	Late 2012	2013	2014	2015	2016	2017
ACS Data set	05-09	06-10	07-11	08-12	09-13	10-14	11-15
File:							
County-to-County	Released	Released	X	X	X	X	X
County/MCD-to-County/MCD	Released	Released	X	X	X	X	X
…by Age		Released					X
…by Sex		Released					X
…by Race		Released					X
…by Hispanic Origin		Released					X
…by Marital Status			?				
…by Place of Birth			?				
…by Nativity by Education				?			
…by Labor Force Status				?			
…by Industry Group					?		
…by Occupation Group					?		
…by Labor Force Status					?		
…by Poverty Status						?	
…by Tenure						?	
…by Individual Income						?	

United States Census Bureau | U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU

52

Contact Information

- Mark.E.Asiala@census.gov
- Useful links:
  - ACS webpage: http://www.census.gov/acs/
  - Design and Methodology Report: http://www.census.gov/acs/www/methodology/methodology_main/ (working on update for 2013 and internet)

United States Census Bureau | U.S. Department of Commerce U.S. CENSUS BUREAU