Using ACS Estimates and Margins of Error
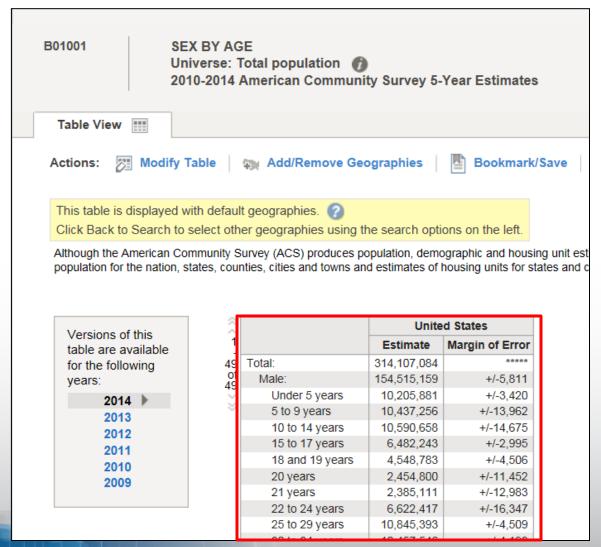
April 6, 2016

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Outline

- What is the Margin of Error (MOE)
- Why do MOEs Matter
- Statistical Testing Using the MOE
- Approximating the MOE
- Resources and References
- Questions

What is the Margin of Error

B01001

SEX BY AGE
Universe: Total population ⓘ
2010-2014 American Community Survey 5-Year Estimates

Table View ▦

Actions: ▥ Modify Table | 🚚 Add/Remove Geographies | 📄 Bookmark/Save

This table is displayed with default geographies. ❓
Click Back to Search to select other geographies using the search options on the left.

Although the American Community Survey (ACS) produces population, demographic and housing unit est
population for the nation, states, counties, cities and towns and estimates of housing units for states and c

Versions of this table are available for the following years:

2014 ▶
2013
2012
2011
2010
2009

	United States	
	Estimate	Margin of Error
Total:	314,107,084	*****
Male:	154,515,159	+/-5,811
Under 5 years	10,205,881	+/-3,420
5 to 9 years	10,437,256	+/-13,962
10 to 14 years	10,590,658	+/-14,675
15 to 17 years	6,482,243	+/-2,995
18 and 19 years	4,548,783	+/-4,506
20 years	2,454,800	+/-11,452
21 years	2,385,111	+/-12,983
22 to 24 years	6,622,417	+/-16,347
25 to 29 years	10,845,393	+/-4,509

What is the Margin of Error?

ACS is a sample and different samples would yield different estimates of the actual population value

The MOE is a measure of the possible variation of the estimate around the population value

Data users can be certain at a given confidence level that the estimate and the actual population value differ by no more than the value of the MOE

Measures of Sampling Variability

Variance

$\updownarrow$

Standard Error (SE) $= \sqrt{\text{Variance}}$

$\updownarrow$

MOE = 1.645 x SE

(90 percent Confidence Level)

(Census Bureau standard is
90 percent confidence level)

Alternate Confidence Levels

Confidence Level	Margin of Error (MOE)
90%	1.645 x SE
95%	1.96 x SE
99%	2.58 x SE

Can convert MOE to different confidence level

$$\text{MOE}_{95\% \text{ confidence level}} = \frac{1.96}{1.645} \times \text{MOE}_{90\% \text{ confidence level}}$$

Why Do MOEs Matter

Geography	Median Household Income ($)	MOE
Block Group 1	37,284	20,922

- Lower Bound = 37,284 − 20,922 = 16,362
- Upper Bound = 37,284 + 20,922 = 58,206
- Confidence Interval ($16,362, $58,206)
(90% Confidence Level)

Why Do MOEs Matter

Geography	Median Household Income ($)	MOE
Block Group 1	37,284	
Block Group 2	42,750	
Block Group 3	56,875	
Block Group 4	66,750	
Block Group 5	76,833	

Why Do MOEs Matter

Geography	Median Household Income ($)	MOE
Block Group 1	37,284	20,922
Block Group 2	42,750	21,302
Block Group 3	56,875	20,956
Block Group 4	66,750	32,130
Block Group 5	76,833	47,268

Testing for Statistical Significance

Definition

A test to determine if a difference is unlikely to occur by chance

To be "statistically different" means there is statistical evidence that there is a difference

ACS Comparison Profile
Year to Year Change

ACS Ranking Tables

Statistical Testing

SELECTED POPULATION PROFILE IN THE UNITED STATES ⓘ 2011 American Community Survey 1-Year Estimates				
	United States			
	Total population		**Asian alone or in combination with one or more other races (400-499) & (100-299) or (300, A01-Z99) or (400-999)**	
Subject	**Estimate**	**Margin of Error**	**Estimate**	**Margin of Error**
TOTAL NUMBER OF RACES REPORTED				
Total population	311,591,919	*****	17,673,522	+/-25,721
One race	97.2%	+/-0.1	85.0%	+/-0.2
Two races	2.6%	+/-0.1	12.9%	+/-0.2
Three races	0.2%	+/-0.1	1.9%	+/-0.1
Four or more races	0.0%	+/-0.1	0.3%	+/-0.1
SEX AND AGE				
Total population	311,591,919	*****	17,673,522	+/-25,721
Male	49.2%	+/-0.1	47.9%	+/-0.1
Female	50.8%	+/-0.1	52.1%	+/-0.1
Under 5 years	6.4%	+/-0.1	7.4%	+/-0.1
5 to 17 years	17.3%	+/-0.1	18.2%	+/-0.1
18 to 24 years	10.0%	+/-0.1	10.6%	+/-0.1
25 to 34 years	13.3%	+/-0.1	16.2%	+/-0.1
35 to 44 years	13.1%	+/-0.1	15.9%	+/-0.1
45 to 54 years	14.3%	+/-0.1	12.9%	+/-0.1
55 to 64 years	12.2%	+/-0.1	9.9%	+/-0.1
65 to 74 years	7.2%	+/-0.1	5.3%	+/-0.1
75 years and over	6.1%	+/-0.1	3.6%	+/-0.1
Median age (years)	37.3	+/-0.1	33.5	+/-0.2
18 years and over	76.3%	+/-0.1	74.4%	+/-0.1
21 years and over	71.8%	+/-0.1	69.9%	+/-0.1
62 years and over	16.7%	+/-0.1	11.5%	+/-0.1
65 years and over	13.3%	+/-0.1	9.0%	+/-0.1

Statistical Testing

Generic formula:

$$\frac{|Est_1 - Est_2|}{\sqrt{MOE_{est1}^2 + MOE_{est2}^2}}$$

Statistical Testing

Median Age:
- Asian alone or in combo: 33.5   +/-   0.2
- Total Population: 37.3   +/-   0.1

STEP	Process	Result
1	Take the difference of the estimates	33.5 − 37.3 = -3.8
2	Take the absolute value of step 1	|-3.8| = abs(-3.8) = 3.8
3	Square the MOEs	$0.2^2 = 0.04$ $0.1^2 = 0.01$
4	Add the squared MOEs together	0.04 + 0.01 = 0.05

Statistical Testing

STEP	Process	Result
5	Take the square root of step 4	$\sqrt{0.05} \approx 0.224$
6	Divide step 2 by step 5	3.8 / 0.224 = 16.99
7	Compare to 1.0	16.99 > 1.0

- If step 7 is greater than 1.0 then the estimates are significant different.

Statistical Testing

Generic formula:

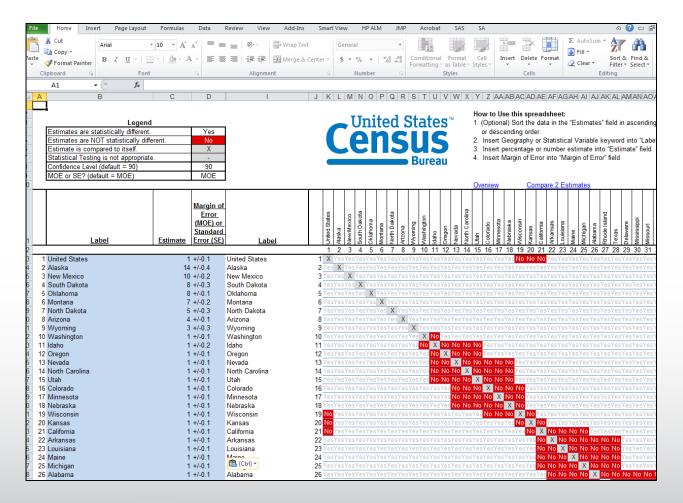$$\frac{|Est_1 - Est_2|}{\sqrt{MOE_{est1}^2 + MOE_{est2}^2}}$$

Example:

$$\frac{|33.5 - 37.3|}{\sqrt{(0.2)^2 + (0.1)^2}} = 16.99$$

Statistical Testing

This method is used for:

- Any type of estimate (count, percent, median, rate, etc.)
- Between years
- Between non-overlapping multi-year periods
- Across geographic areas
- Between surveys (e.g. ACS vs Census)
    - Provided the ACS estimate is comparable to the Census

https://www.census.gov/programs-surveys/acs/guidance/comparing-acs-data.html

Statistical Testing Tool

Special Case
Controlled Estimates

- Controlled estimates:
  - MOE = ***** (5 asterisks)
  - Set MOE = 0 for statistical testing

B01001	SEX BY AGE Universe: Total population 2013 American Community Survey 1-Year Estimates		
		United States	
		Estimate	Margin of Error
Total:		316,128,839	*****
Male:		155,627,698	+/-26,501
Under 5 years		10,109,150	+/-17,055
5 to 9 years		10,516,217	+/-41,359
10 to 14 years		10,622,312	+/-38,115
15 to 17 years		6,402,435	+/-12,852

Special Case
Zero Estimate MOEs

- Zero estimates will have an MOE
- MOEs for zero estimates are model-based

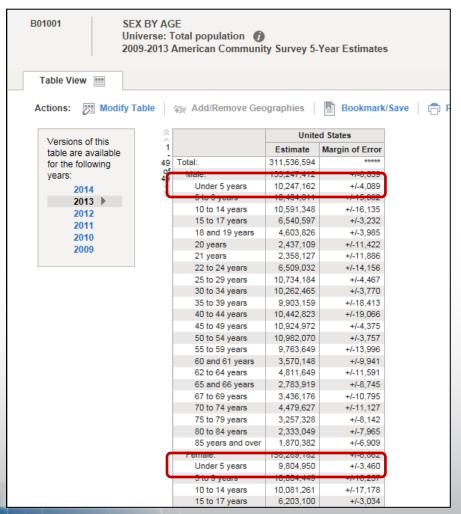| B01001E	SEX BY AGE (NATIVE HAWAIIAN AND OTHER PACIFIC ISLANDER ALONE)
	Universe: People who are Native Hawaiian and Other Pacific Islander alone
	2009-2013 American Community Survey 5-Year Estimates

	Delaware		District of Columbia		Maryland		Virginia	
	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error
Total:	567	+/-337	233	+/-94	2,570	+/-367	5,633	+/-541
Male:	261	+/-159	134	+/-90	1,271	+/-263	2,697	+/-336
Under 5 years	36	+/-56	0	+/-29	29	+/-23	132	+/-62
5 to 9 years	0	+/-27	0	+/-29	110	+/-93	82	+/-47
10 to 14 years	0	+/-27	34	+/-48	55	+/-50	324	+/-117
15 to 17 years	0	+/-27	0	+/-29	78	+/-82	141	+/-97
18 and 19 years	3	+/-8	0	+/-29	20	+/-25	144	+/-89
20 to 24 years	2	+/-4	0	+/-29	363	+/-314	340	+/-186
25 to 29 years	2	+/-6	0	+/-29	131	+/-99	419	+/-170

Special Case
Medians and Aggregates

- Median and Aggregates with too few observations:
  - Estimate = "-", MOE = "**"

- Medians in upper or lower category:
  - Median income in the past 12 months
  - Estimate = "$2,500-", MOE = "***"

- NO statistical testing possible

Deriving New Estimates
Must approximate the MOE

Approximating the MOE

Wish to calculate total number of children under the age of 5 years old

- Sum the estimates for males and females
- Approximate MOE:

$$MOE_{Aggreg} = \sqrt{MOE_{est1}^2 + MOE_{est2}^2 \ldots}$$

Approximating the MOE

Characteristics	Estimate	MOE	MOE Squared
Under 5 years, Males	10,247,162	+/-4,089	16,719,921
Under 5 years, Females	9,804,950	+/-3,460	11,971,600

Total, Under 5 Years Old =
10,247,162 + 9,804,950 = 20,052,112

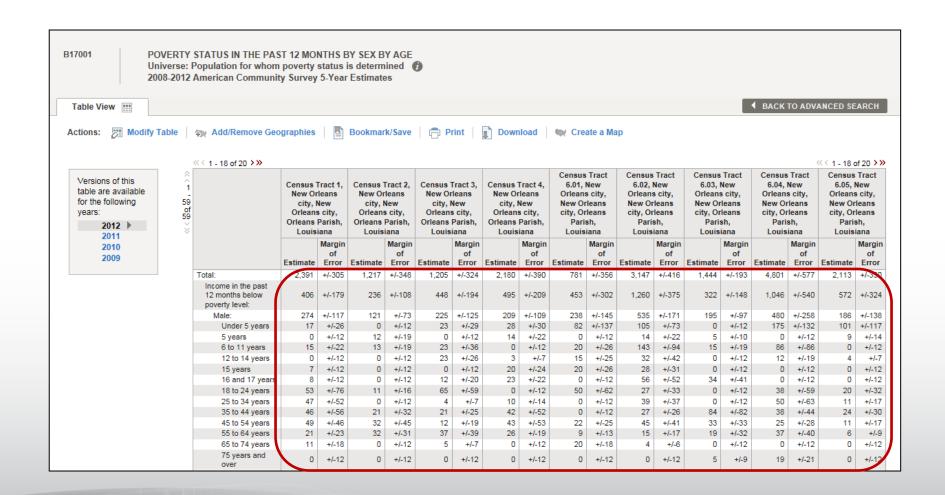$$MOE_{Total} = \sqrt{4,089^2 + 3,460^2} \approx 5,356.4$$

Approximating the MOE

Characteristics (Native Hawaiians)	Estimate	MOE
Under 5 years old (Delaware)	36	56
5 to 9 years old (Delaware)	0	27
Under 5 years old (Washington, D.C.)	0	29
5 to 9 years old (Washington, D.C.)	0	29
TOTAL	36	63.06

- MOE for zero estimates are based on a model
- When approximating a sum, use only the largest zero estimate MOE, once

$$MOE(Total) \approx \sqrt{56^2 + 29^2} \approx 63.06$$
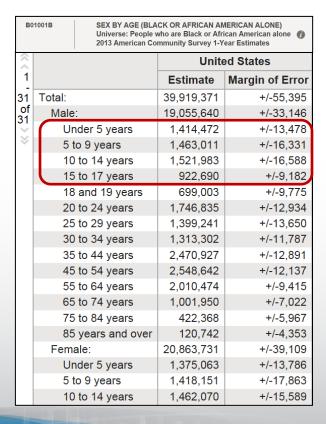
Estimates with Large MOEs

Estimates with Large MOEs

- Some estimates have MOEs larger than the estimate

- This may occur for small geographies or small populations

- If this occurs
  - Use a larger geography
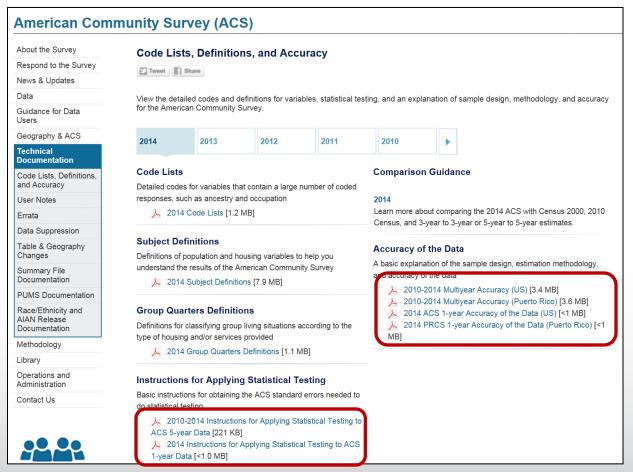 - Combine estimates across characteristics, geographies or both

Collapsed Tables

Detailed Table

B01001B	SEX BY AGE (BLACK OR AFRICAN AMERICAN ALONE) Universe: People who are Black or African American alone 2013 American Community Survey 1-Year Estimates

	United States	
	Estimate	Margin of Error
Total:	39,919,371	+/-55,395
Male:	19,055,640	+/-33,146
Under 5 years	1,414,472	+/-13,478
5 to 9 years	1,463,011	+/-16,331
10 to 14 years	1,521,983	+/-16,588
15 to 17 years	922,690	+/-9,182
18 and 19 years	699,003	+/-9,775
20 to 24 years	1,746,835	+/-12,934
25 to 29 years	1,399,241	+/-13,650
30 to 34 years	1,313,302	+/-11,787
35 to 44 years	2,470,927	+/-12,891
45 to 54 years	2,548,642	+/-12,137
55 to 64 years	2,010,474	+/-9,415
65 to 74 years	1,001,950	+/-7,022
75 to 84 years	422,368	+/-5,967
85 years and over	120,742	+/-4,353
Female:	20,863,731	+/-39,109
Under 5 years	1,375,063	+/-13,786
5 to 9 years	1,418,151	+/-17,863
10 to 14 years	1,462,070	+/-15,589

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Collapsed Table

C01001B	SEX BY AGE (BLACK OR AFRICAN AMERICAN ALONE) Universe: People who are Black or African American alone 2013 American Community Survey 1-Year Estimates

	United States	
	Estimate	Margin of Error
Total:	39,919,371	+/-55,395
Male:	19,055,640	+/-33,146
Under 18 years	5,322,156	+/-21,007
18 to 64 years	12,188,424	+/-25,229
65 years and over	1,545,060	+/-7,099
Female:	20,863,731	+/-39,109
Under 18 years	5,139,441	+/-24,134
18 to 64 years	13,394,099	+/-23,559
65 years and over	2,330,191	+/-8,186

1-9 of 9

Resources

Compass Handbooks

American Community Survey (ACS)

- About the Survey
- Respond to the Survey
- News & Updates
- Data
- **Guidance for Data Users**
  - Subjects Included in the Survey
  - Which Data Tool Should I Use?
  - When to Use 1-year, 3-year, or 5-year Estimates
  - Handbooks
  - Comparing ACS Data
  - Training Presentations
- Geography & ACS
- Technical Documentation
- Methodology
- Library
- Operations and Administration

Handbooks for Data Users

You can use American Community Survey (ACS) data in different ways and for different reasons. Each one of our downloadable PDF Compass handbooks helps a particular group with specific how-to instructions and/or case studies.

For an introduction to ACS data, we recommend the compass handbook for General Data Users.

What Congress Needs to Know
November 2008
This handbook helps congressional staff use ACS data to respond to constituent inquiries, draft floor/press statements, conduct legislative research, and more.

What Federal Agencies Need to Know
December 2008
This handbook helps federal agencies use ACS data for eligibility determinations, allocation of funds, program parameters, and more.

What General Data Users Need to Know
October 2008
This handbook helps general data users learn how to access and use ACS data and provide concrete examples of how ACS data can answer real-world questions.

http://www.census.gov/programs-surveys/acs/guidance/handbooks.html

United States Census Bureau

U.S. Department of Commerce
Economics and Statistics Administration
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Training Presentations

American Community Survey (ACS)

- About the Survey
- Respond to the Survey
- News & Updates
- Data
- **Guidance for Data Users**
  - Subjects Included in the Survey
  - Which Data Tool Should I Use?
  - When to Use 1-year, 3-year, or 5-year Estimates
  - Handbooks
  - Comparing ACS Data
  - Training Presentations
- Geography & ACS
- Technical Documentation
- Methodology
- Library
- Operations and Administration

Training Presentations

Tweet   Share

Want to learn more about American Community Survey (ACS) data and data products? Need to train others how to understand the data? These compass presentations can help.

An Overview of the American Community Survey
February 2013
Basics of the American Community Survey program and website, with information on content, survey methodology, and data products.

Data Products from the American Community Survey
February 2013
Examples and suggestions for using data profiles, tables, and Public Use Microdata Sample (PUMS) Files.
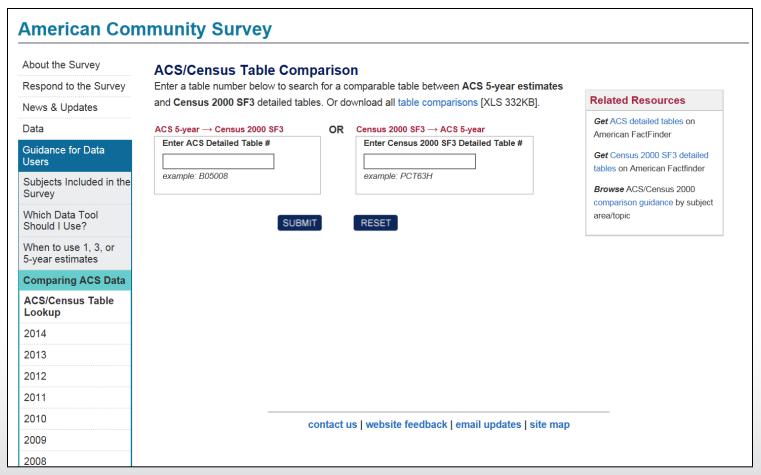
Things that May Affect Estimates from the American Community Survey
February 2013
Because the American Community Survey is a sample survey, sampling error is inevitable.
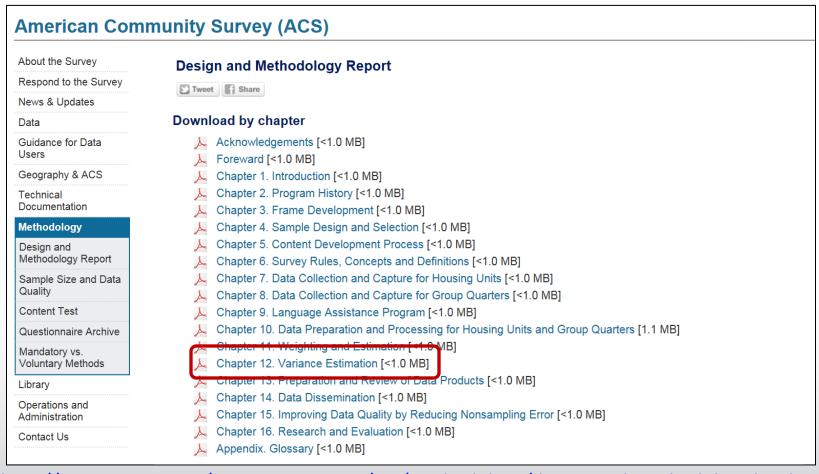
http://www.census.gov/programs-surveys/acs/guidance/training-presentations.html

Crosswalk

http://www.census.gov/acs/www/guidance/comparing-acs-data/acscensus-table-lookup
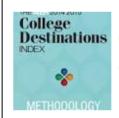
Design and Methodology

American Community Survey (ACS)

About the Survey

Respond to the Survey

News & Updates

Data

Guidance for Data Users

Geography & ACS

Technical Documentation

Methodology

Design and Methodology Report

Sample Size and Data Quality

Content Test

Questionnaire Archive

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Design and Methodology Report

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Download by chapter

- Acknowledgements [<1.0 MB]
- Foreward [<1.0 MB]
- Chapter 1. Introduction [<1.0 MB]
- Chapter 2. Program History [<1.0 MB]
- Chapter 3. Frame Development [<1.0 MB]
- Chapter 4. Sample Design and Selection [<1.0 MB]
- Chapter 5. Content Development Process [<1.0 MB]
- Chapter 6. Survey Rules, Concepts and Definitions [<1.0 MB]
- Chapter 7. Data Collection and Capture for Housing Units [<1.0 MB]
- Chapter 8. Data Collection and Capture for Group Quarters [<1.0 MB]
- Chapter 9. Language Assistance Program [<1.0 MB]
- Chapter 10. Data Preparation and Processing for Housing Units and Group Quarters [1.1 MB]
- Chapter 11. Weighting and Estimation [<1.0 MB]
- Chapter 12. Variance Estimation [<1.0 MB]
- Chapter 13. Preparation and Review of Data Products [<1.0 MB]
- Chapter 14. Data Dissemination [<1.0 MB]
- Chapter 15. Improving Data Quality by Reducing Nonsampling Error [<1.0 MB]
- Chapter 16. Research and Evaluation [<1.0 MB]
- Appendix. Glossary [<1.0 MB]

http://www.census.gov/programs-surveys/acs/methodology/design-and-methodology.html

Source Us!

U.S. Census Bureau's *[YYYY-YYYY]* American Community Survey *[1/3/5]*-year *[estimates/statistics/data release]*

College Destinations: How We Rank Them
American Institute for Economic Research - Apr 7, 2014
Sources: **U.S. Census Bureau**; **American Community Survey**, **2011**
American Community Survey 1-Year Estimates, Table B01003;
using ...

NMSU Valencia County Extension providing youth develo…
New Mexico State University NewsCenter - Apr 14, 2015
... Mexico and $53,046 for the United States, according to the **U.S. Census Bureau's 2009-2013 American Community Survey 5-Year Estimate.**

Census Estimates Show Progress Toward ACA Coverag…
Health Affairs (blog) - Sep 28, 2015
Source: **U.S. Census Bureau**, 2013 and **2014 American Community Survey 1-year estimates** from Table S2701 in American Fact Finder.

Continue the Conversation #ACSdata

Sign up for and manage alerts at https://public.govdelivery.com/accounts/USCENSUS/subscriber/new

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More information on the American Community Survey: http://www.census.gov/acs

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youtube.com/user/uscensusbureau

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United States Census Bureau

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AMERICAN COMMUNITY SURVEY DATA USERS GROUP

- Purpose:
  - Improve understanding of the value and utility of ACS data.
  - Promote information sharing among data users about key ACS data issues and applications
- Membership is free and open to all interested ACS data users
- Webinars and special sessions at professional meetings planned
- Users group website and online community

http://www.acsdatausers.org/

Need Local Stats?

- Assistance Near You!

  Our regional data staff can help you access local statistics from the ACS or offer training to help build your skills.

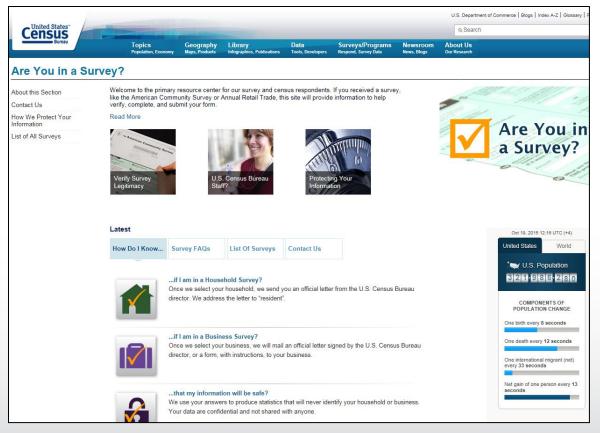- Contact us at: clmso.ddb.questions@census.gov

Questions?

- Please fill out the evaluation for this presentation
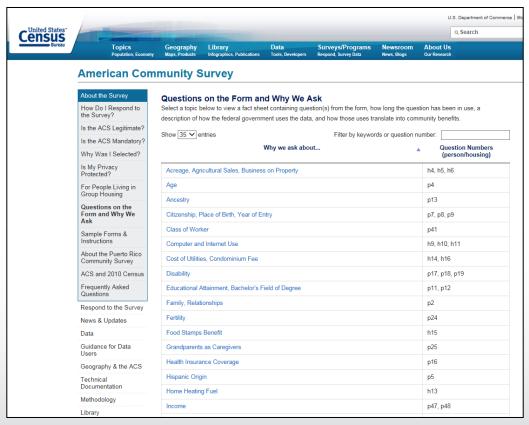
Bonus Slide:
Finding Your Geographies

Bonus Slide:
How to Determine if you are in a Survey

http://www.census.gov/programs-surveys/are-you-in-a-survey.html

Bonus Slide:
Why We Ask the Questions on the ACS

http://www.census.gov/acs/www/about/why-we-ask-each-question/

Bonus Slide: Explanation of Detailed Table Code

B01001APR

- B is for Detailed Table, C is for Collapsed
- 01 is a 2-digit code for the subject (https://ask.census.gov/faq.php?id=5000&faqId=1687) (New series: B28 for Computers and Internet)
- 001 is the table number
- A is if the table is a race/Hispanic iterated table (A is white alone non-Hispanic, iterations are A through I)
- PR appears only if the table is published exclusively for Puerto Rico