Things That May Affect Estimates from the American Community Survey

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Overview

- Definition of sampling error
- Measures associated with sampling error
  - Standard error
  - Margin of error
  - Confidence intervals
  - Coefficient of variation
- How to use measures associated with sampling error
- Non-sampling error
- Population controls

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Definition of Sampling Error

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What is Sampling Error?

Definition

The **uncertainty** associated with an estimate that is based on data gathered from a sample of the population rather than the full population

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Illustration of Sampling Error

Estimate average number of children per household for a population with 3 households:

Household A	1 child
Household B	2 children
Household C	3 children

Average based on the full population is two children per household

Conceptualizing Sampling Error

Three different samples:

1. Households A and B (1 child, 2 children)
2. Households B and C (2 children, 3 children)
3. Households A and C (1 child, 3 children)

Three different averages:

1. 1.5 children (1 + 2) / 2
2. 2.5 children (2 + 3) / 2
3. 2 children (1 + 3) / 2

Measures associated with sampling error

Measures Associated with Sampling Error

- Standard Error (SE)
- Margin of Error (MOE)
- Confidence Interval (CI)
- Coefficient of Variation (CV)

Standard Error (SE)

Definition

A measure of the variability of an estimate due to sampling

Depends on variability in the population and sample size

Foundational measure

Standard Error (SE)

Formula

SE = MOE / 1.645

2007 ACS Data for Baltimore City:

52.1% Percent of males who have never married
1.7% Margin of Error

SE = 1.7% / 1.645
SE = 1.033%

Margin of Error (MOE)

Definition

A measure of the precision of an estimate at a given level of confidence (90%, 95%, 99%)

Confidence level of a MOE

MOEs at the 90% confidence level for all published ACS estimates

Margin of Error (MOE)

Formula

MOE = +/-1.645 x SE (90% level)

Values for other confidence levels

95% = 1.960
99% = 2.576

Interpreting Margin of Error

- Indicates that a data user can be 90 percent certain that the estimate and the population value differ by no more than the value of the MOE
- MOE can help data users assess the reliability of an estimate
- MOE can help data users avoid misinterpreting small differences between estimates as significant

Interpreting Margin of Error

Example for Baltimore City:

52.1% Percent of males who have never married
1.7% Margin of Error

- Indicates 90 percent chance that the estimate of 52.1% and the population value differ by no more than 1.7%
- Size of MOE relative to size of estimate

Confidence Interval

Definition

A range that is expected to contain the population value of the characteristic with a known probability.

Confidence Interval

Formula

$$L_{CL} = \hat{X} - MOE_{CL}$$

$$U_{CL} = \hat{X} + MOE_{CL}$$

where

L_{CL} is the lower bound at the desired confidence level

U_{CL} is the upper bound at the desired confidence level

$\hat{X}$ is the ACS estimate and

MOE_{CL} is the margin of error at the desired confidence level

Confidence Interval

Calculation Example for Baltimore City

52.1% – 1.7% = 50.4%

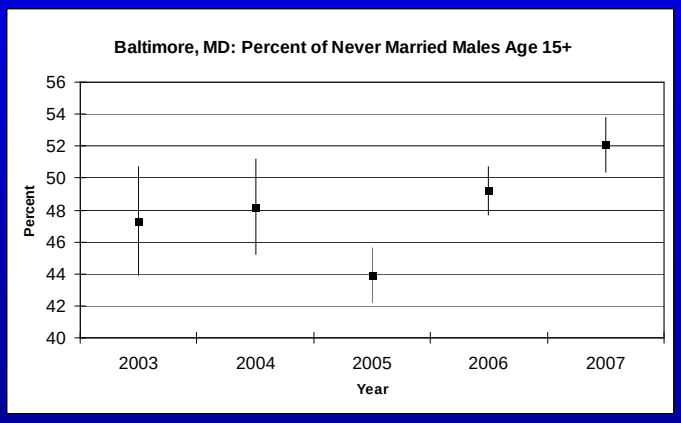
52.1% + 1.7% = 53.8%

Confidence Interval = 50.4% to 53.8%

Confidence Interval Interpretation

- We can be 90 percent certain that the confidence interval from 50.4% to 53.8% contains the population value of never married males 15 years and older in Baltimore City
- Useful to display confidence intervals

Displaying Confidence Intervals



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Coefficient of Variation (CV)

Definition

The relative amount of sampling error associated with a sample estimate

Formula

CV = SE / Estimate * 100%

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Coefficient of Variation (CV)

Example for Baltimore City

Estimate = 52.1% of never married males
Standard Error = 1.033%

CV = SE / Estimate * 100%
CV = 1.033% / 52.1% * 100%
CV = 1.98%

Interpreting Coefficients of Variation

- Size of the CV
- In Baltimore City example, the CV is small (< 2%) indicating this is a reliable estimate
- No hard-and-fast rules about the size of CVs
- Caution for proportions close to zero

Sampling Error is Related to Sample Size

- The larger the sample size, the smaller the uncertainty or sampling error
- Combining ACS data from multiple years increases sample size and reduces sampling error
- All sample surveys have sampling error – including decennial census long-form data

How to use measures associated with sampling error

How are Measures of Sampling Error Used?

- To indicate the statistical reliability and usability of estimates
- To make comparisons between estimates
- To conduct tests of statistical significance
- To help users draw appropriate conclusions about data

Case Study

Tracking Economic Well-Being in Washington, DC

- In 2005, city implements a series of job training initiatives to increase employment and reduce poverty rates
- In 2008, public officials want to assess changes in poverty rates in the city

Finding the Data

- Washington, DC has a population size greater than 65,000
- Comparable data for both 2006 and 2007 are available from the ACS
- Examine change in the percent of people living in poverty from 2006 to 2007

Finding the Data

2006 ACS data for Washington, DC

19.6% % of all people living in poverty
1.4% Margin of error

2007 ACS data for Washington, DC

16.4% % of all people living in poverty
1.4% Margin of error

Are the Estimates Reliable and Usable?

Check CVs for each estimate

2006: SE = 0.85% = (1.4% / 1.645)

CV = 4.3% = (0.85% / 19.6%) * 100

2007: SE = 0.85% = (1.4% / 1.645)

CV = 5.2% = (0.85 %/ 16.4%) * 100

Result = Both estimates are reliable

Comparing the Estimates

Compare Confidence Intervals:

2006: 18.2% - 21.0% (19.6 +/- 1.4)
2007: 15.0% - 17.8% (16.4 +/- 1.4)

- Is there a significant difference?

Test of Statistical Significance

Definition

A test to determine if it is unlikely that something has occurred by chance

A "statistically significant difference" means there is statistical evidence that there is a difference

Conducting Tests of Statistical Significance

Formula

$$\left| \frac{\hat{X}_1 - \hat{X}_2}{\sqrt{SE_1^2 + SE_2^2}} \right| > Z_{CL}$$

where Z_{CL} is the critical value for the desired confidence level

Z_{CL} for 90% confidence level = 1.645

Testing for Statistical Significance

Substituting the appropriate values:

$$\left| \frac{19.6 - 16.4}{\sqrt{(0.85)^2 + (0.85)^2}} \right| = 2.662$$

- 2.662 > 1.645
- Difference is statistically significant at the 90% confidence level

Drawing Appropriate Conclusions

- Short-term fluctuations versus real trends
- Increasing confidence level to 95% or 99%
  - Z_{CL} for 95% confidence level = 1.960
  - Z_{CL} for 99% confidence level = 2.576

Non-sampling error

What is Non-Sampling Error?

Definition

Any error affecting a survey or census estimate apart from sampling error

Occurs in complete censuses as well as in sample surveys

Types of Non-Sampling Error

- Non-Response Error
- Response Error
- Processing Error
- Coverage Error

Population controls

Population Controls

- Independent information used to increase the precision of the ACS estimates
- Reduces sampling and non-sampling errors in the ACS estimates
- Time series of population estimates are revised annually but the ACS estimates for previous years are not.

Summary

What Have We Learned?

- All surveys have sampling and non-sampling error
- Four key measures of sampling error are standard error, margin of error, confidence interval, and coefficient of variation
- Measures of sampling error provide important information about the reliability of ACS estimates

What Have We Learned?

- Sampling error measures can be used to make comparisons between estimates and to conduct tests of statistical significance
- Understanding and using measures of sampling error helps users draw appropriate conclusions about ACS data

For more information

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