WHAT DO MARGINS OF ERROR TELL US ABOUT SMALL AREA ACS DATA?

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IMPORTANCE OF MARGINS OF ERROR

- Concern with accuracy of ACS data
- Users advised to mind MOEs
  - Often an admonishment
- Idea:
  - Don’t use ACS with blind faith
  - Steer clear of inaccurate estimates
  - Avoid drawing erroneous conclusions

IMPORTANCE OF MARGINS OF ERROR

- Users wonder: Is this estimate accurate?
  - Does MOE tell us?
- Called margin of "error"
  - MOE measures sampling error
  - More about uncertainty
- Estimates can have
  - Large MOE and small error
  - Small MOE and large error
- MOEs subject to own uncertainty

IMPORTANCE OF MARGINS OF ERROR

- Work done out of curiosity
- A look at ACS MOEs
  - Data from both ACS and census
- Two views of “error”
  - Error implied by MOE
  - Actual error (ACS vs. census)
- What if we could compare MOEs and actual error?

DATA

- Households Type by household Size
  - 2010 Census
  - ACS 5-year data 2008-2012
- Content as follows
- Similar at national level

HOUSEHOLDS BY TYPE/SIZE: US PERCENT DISTRIBUTION

HH Type/Size	2010 Census	ACS 2008-2012
Fam 2 persons	27.32	28.54
Fam 3 persons	15.22	15.13
Fam 4 persons	13.04	13.07
Fam 5 persons	6.35	6.00
Fam 6 persons	2.59	2.28
Fam 7+ persons	1.92	1.45
Nonfam 1 person	26.74	27.45
Nonfam 2 persons	5.45	4.96
Nonfam 3 persons	0.85	0.72
Nonfam 4 persons	0.35	0.28
Nonfam 5 persons	0.11	0.08
Nonfam 6 persons	0.04	0.02
Nonfam 7+ persons	0.03	0.01

DATA

- Analyzed 216,159 block groups
  - Where ACS and Census HHs GT 0
- 2,810,067 estimates
  - 13 cells per block group
- Census-ACS comparison is imperfect
  - ACS 2008-2012 is centered on 2010
  - Basis for rough comparison
  - Shed some light on MOEs

90 PERCENT CONFIDENCE INTERVAL

- MOEs - 90 pct confidence interval
  - 90 pct of census - within ACS +/- MOE
- Computed upper and lower bound
  - If ACS = 60 and MOE = 20
  - Upper = 80 Lower = 40
- 69 pct of lower bound estimates LT 0
  - Reminder that MOE can imply unrealistic values
- Recoded negative to 0

BGs WITH CENSUS COUNT WITHIN ACS ESTIMATE +/- MOE

HH Type/Size	Percent
All Estimates	87.9
Fam 2 persons	85.0
Fam 3 persons	80.1
Fam 4 persons	79.2
Fam 5 persons	74.3
Fam 6 persons	82.1
Fam 7+ persons	88.4
Nonfam 1 person	83.5
Nonfam 2 persons	74.3
Nonfam 3 persons	97.0
Nonfam 4 persons	99.2
Nonfam 5 persons	99.8
Nonfam 6 persons	99.95
Nonfam 7+ persons	99.97

90 PERCENT CONFIDENCE INTERVAL

- MOEs as advertised
  - Census within Upper-Lower 87.9 pct of the time
- But varies by HH Type/Size
  - Low of 74 pct (Fam 5 and Nonfam 2)
  - High 99.97 pct (Nonfam 7+ persons)
    - Census and ACS often 0
    - Negative Lower Bound recodes to 0
- What if estimates expressed as pct of total HHs?

PERCENT BGs WITH CENSUS WITHIN ACS +/- MOE

HH Type/Size	Based on numbers	Based on pct of total
All Estimates	87.1	56.5
Fam 2 persons	85.0	2.5
Fam 3 persons	80.1	14.9
Fam 4 persons	79.2	21.6
Fam 5 persons	74.3	39.4
Fam 6 persons	82.1	55.3
Fam 7+ persons	88.4	67.7
Nonfam 1 person	83.5	4.6
Nonfam 2 persons	74.3	43.1
Nonfam 3 persons	97.0	88.3
Nonfam 4 persons	99.2	97.3
Nonfam 5 persons	99.8	99.4
Nonfam 6 persons	99.95	99.8
Nonfam 7+ persons	99.97	99.9

90 PERCENT CONFIDENCE INTERVAL

- 90 pct interval less relevant for percent of total
  - Census pct within Upper-Lower pct **56.5** pct of time
- Upper & Lower pct distributions can be distorted
  - Many estimates should be 0
  - MOE assigns Upper percent to ALL
  - Must sum to 100 percent
  - Reduces percent in populated categories

ACS PUBLISHED, UPPER LOWER vs CENSUS

- MOE does not define range of likely values
- ACS = 60 and MOE = 20
  - Does not mean
  - “Actual could just as easily be 80 or 40”
- Actual value (census)
  - On average . . .
  - Should be closer to ACS Published
  - Than to Upper or Lower bound
- Is that the case?

MEAN ABS PCT ERROR: ACS PUBLISHED, UPPER, LOWER VS. CENSUS

HH Type/Size	ACS Published	ACS Upper	ACS Lower
Fam 2 persons	**28.8**	62.4	48.9
Fam 3 persons	**41.2**	83.7	70.0
Fam 4 persons	**46.9**	96.7	73.9
Fam 5 persons	**68.0**	137.0	88.4
Fam 6 persons	104.0	231.4	**95.3**
Fam 7+ persons	113.9	316.1	**92.8**
Nonfam 1 person	**31.7**	66.9	53.8
Nonfam 2 persons	**77.7**	151.6	92.8
Nonfam 3 persons	137.5	504.7	**86.0**
Nonfam 4 persons	95.7	526.0	**61.2**
Nonfam 5 persons	44.2	368.9	**32.4**
Nonfam 6 persons	18.0	232.7	**14.8**
Nonfam 7+ persons	12.7	197.7	**11.0**

Lowest error in **bold**

ACS PUBLISHED, UPPER LOWER vs CENSUS

- Mean error high for all type/size
- ACS Published generally more accurate
- Exceptions: "Lower" sometimes more accurate
  - HHs with many persons
  - Many values = 0
  - Lower Bound recoded to 0
  - Error = 0
  - Reduces mean error

MOE AS INDICATOR OF ERROR

- How well do MOEs identify estimation error?
- Compared two types of “error”
  - MOE-based (MOE as percent of estimate)
  - Census-based (Abs pct diff ACS vs. census)
- Does MOE-based error correlate with census-based error?

CORRELATION BETWEEN MOE-BASED AND CENSUS-BASED ERROR

HH Type/Size	Bivariate Corr
Fam 2 persons	0.281
Fam 3 persons	0.189
Fam 4 persons	0.165
Fam 5 persons	-0.014
Fam 6 persons	-0.044
Fam 7+ persons	0.022
Nonfam 1 person	0.205
Nonfam 2 persons	-0.044
Nonfam 3 persons	0.206
Nonfam 4 persons	0.269
Nonfam 5 persons	0.257
Nonfam 6 persons	0.253
Nonfam 7+ persons	0.191

MOE AS INDICATOR OF ERROR

- Correlation positive but weak
  - Across Type/Size categories
  - Negative for a few
- Surprising only if MOE viewed as measure of error
- A look at example BGs can help

MOE-BASED AND CENSUS-BASED ERROR: BG 4 013 103612 4

HH Type/Size	Census	ACS	MOE	MOE-err	Census-err
Fam 2 persons	87	87	98	112.6	0.0
Fam 3 persons	**66**	**124**	**87**	**70.2**	**87.9**
Fam 4 persons	31	32	56	175.0	3.2
Fam 5 persons	13	7	15	214.3	46.2
Fam 6 persons	3	0	13	100.0	100.0
Fam 7+ persons	3	0	13	100.0	100.0
Nonfam 1 person	267	223	119	53.4	16.5
Nonfam 2 persons	60	71	67	94.4	18.3
Nonfam 3 persons	3	0	13	100.0	100.0
Nonfam 4 persons	1	0	13	100.0	100.0
Nonfam 5 persons	0	0	13	100.0	0.0
Nonfam 6 persons	0	0	13	100.0	0.0
Nonfam 7+ persons	0	0	13	100.0	0.0
Total	534	544			

MOE-BASED AND CENSUS-BASED ERROR: BG 4 013 103612 4

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Fam 2 persons	**87**	**87**	**98**	**112.6**	**0.0**
Fam 3 persons	66	124	87	70.2	87.9
Fam 4 persons	31	32	56	175.0	3.2
Fam 5 persons	13	7	15	214.3	46.2
Fam 6 persons	3	0	13	100.0	100.0
Fam 7+ persons	3	0	13	100.0	100.0
Nonfam 1 person	267	223	119	53.4	16.5
Nonfam 2 persons	60	71	67	94.4	18.3
Nonfam 3 persons	3	0	13	100.0	100.0
Nonfam 4 persons	1	0	13	100.0	100.0
Nonfam 5 persons	0	0	13	100.0	0.0
Nonfam 6 persons	0	0	13	100.0	0.0
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Nonfam 3 persons	3	0	13	100.0	100.0
Nonfam 4 persons	1	0	13	100.0	100.0
Nonfam 5 persons	**0**	**0**	**13**	**100.0**	**0.0**
Nonfam 6 persons	**0**	**0**	**13**	**100.0**	**0.0**
Nonfam 7+ persons	**0**	**0**	**13**	**100.0**	**0.0**
Total	534	544			

BG IN MARICOPA, AZ

- Families with 2 people
  - MOE-based error = 112.6
  - Census-based error = 0
  - ACS and Census = 87
- Families with 3 people
  - MOE-based error = 70.2
  - Census-based error = 87.9
- MOE suggests larger error for Fam 2 than Fam 3
- Weak correlation no surprise

MOE-BASED AND CENSUS-BASED ERROR: BG 6 029 005501 4

HH Type/Size	Census	ACS	MOE	Probability of Zero
Fam 2 persons	43	91	104	LT 0.1
Fam 3 persons	17	0	13	0.1
Fam 4 persons	21	0	13	0.2
Fam 5 persons	9	0	13	0.6
Fam 6 persons	3	0	13	2.1
Fam 7+ persons	5	0	13	5.8
Nonfam 1 person	102	158	80	LT 0.1
Nonfam 2 persons	13	0	13	0.2
Nonfam 3 persons	1	0	13	13.8
Nonfam 4 persons	1	0	13	38.7
Nonfam 5 persons	0	0	13	67.6
Nonfam 6 persons	0	0	13	85.2
Nonfam 7+ persons	0	0	13	89.0
Total	215	249		

BG IN KERN, CA

- ACS = 0 for all but two categories
- MOE = 13 for all “0” estimates
- Regardless of probability actual value = 0

- For Nonfam 7+
  - MOE tells us 90 pct probability real value is between 13 and 0 (or 13 and -13)
  - Census tells us 90 pct probability real value is exactly 0
  - MOE does not account for that probability

CONCLUSIONS

- Results confirm MOE 90 as pct confidence interval
  - But varies by type/size cell
  - More relevant to number than percent of total
- ACS Published estimates
  - Generally more accurate than Upper/Lower bound
- Weak correlation
  - Between MOE-based and Census-based error
  - High MOE can have Low error
  - Low MOE can have High error . . . But less common
  - Few BGs have Low MOE-based error

CONCLUSIONS

- Many ACS estimates are “0”
  - Census often “0” but MOE never “0”
  - Beware MOEs for “0” estimates
- Just as ACS challenged for small areas
  - So too are MOEs
- Results:
  - For just one table
  - Depend on comparison of ACS and census data
  - But no surprise

CONCLUSIONS

- Reminder
  - MOEs subject to uncertainty
  - Don’t tell if specific estimate is accurate
- Mind your MOEs
  - Don’t use ACS with blind faith
  - Don’t use MOEs with blind faith

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THANK YOU