Developmental Estimates of Subnational Crime Rates Based on the National Crime Victimization Survey

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Overview

• National Crime Victimization Survey (NCVS)-Basics

• Subnational Program: Utility and Approaches
  • Direct
  • Local victimization surveys
  • Model-based/Small area estimates

• Small area estimation (SAE) project
  • Context
  • Methodology
  • Key findings

• Using NCVS SAE estimates
NCVS Basics

- Omnibus Crime Survey: focus on violence and property crime
- Annual victimization counts/rates
- Provides a national measure of change
- “Dark figure”- unreported crime
- Standardized data collection process and instrument
- Incident and attribute based collection
NCVS Basics

Design

• Non-institutionalized households in the U.S.
• Rotating panel design, interviews conducted every 6 months over 3 years
• Nationally representative sample
• All eligible persons 12 or older in sampled households are interviewed
• Interviews: Currently 90,000 households and 170,000 persons per year
• First interview in-person, follow-up interviews by phone or in-person
• Census Bureau = collection agency
• Response rates: 90% household; 88% individuals
Subnational Efforts: Utility

Value of Information:

- Victimization statistics (dark figure) coupled with police statistics at the local level- Number and rate of victimization. Who is at risk?

- Resource allocation

- Evaluate local crime policy

- Evaluate planned interventions

- Exploit cross state/city/county variation to better understand causes of crime and solutions

- Link to other sources of information at the local level (victim service providers, corrections/reentry, police resources)
Subnational Efforts: Current Limitations/Challenges

• Current NCVS sample is designed to be representative at the national-level, not necessarily for states, cities, or other smaller geographic areas

• Smaller geographic areas:
  • Lack reliability- small sample sizes lack precision
  • Representation- existing sample may not represent the area

• Subsequently, can’t say much about specific states, cities, etc.
Subnational Estimation Approaches

1. Direct estimation
   i. Pilot study in 11 states: 2013-2016
   ii. 2015/16 sample redesign: 22 states

2. Low cost companion study

3. Model-based, small area estimation
Direct estimates- NCVS core sample boost

• Boost sample sizes in large states
• Allocate state sample to better represent area/validity

Advantages
- Provides content of NCVS and NCVS supplements at subnational level
- Estimates based on direct survey data
- Provides subnational data not currently available through official statistics (e.g. victim characteristics, victim-offender relationship, ‘dark figure’ of crime)
- Can be used to assess resident perceptions of and satisfaction with police

Limitations
- Cost
- Sample sizes (precision/reliability)
- Disclosure risk
Low cost companion study

Low cost companion study to the core NCVS to produce local area estimates

Pilot study complete 2014
• Self-administered mailed addressed-based survey
• Victimization rates and reporting to the police
• Non-crime items: disorder, fear, police performance

Phase 2: 2015/2016
• Received OMB clearance for 2-wave field test (~112,500 per wave)
• 40 largest CBSAs, oversampling in 3 to test sub-CBSA estimation (Chicago, LA, Philadelphia)
• Compare trends (or change estimates), cross-CBSA comparisons to NCVS
Model-based estimates: Overview

A panel of the National Academy of Sciences recommended in 2008 that BJS consider development of small area estimates from the NCVS

Small area estimation (SAE) is a methodologically different approach from direct estimation used for most survey analysis.

First phase: Broad review of SAE possibilities by Cantor, Krenzke, Stukel, and Rizzo (2010)

Second phase: BJS extended an existing research grant to Fay, in collaboration with Mamadou S. Diallo, Ph.D., to develop an approach that could be implemented for states and possibly other geographic entities
SAE Project Overview

Work carried out using NCVS internal files at Census Bureau under sworn special status, and all results cleared by Census Bureau Disclosure Review Board

Initial investigations started Aug. 2011

Initial thoughts presented at FCSM in Jan. (Li, Diallo, and Fay 2012)

Other proceedings papers at statistical meetings (FCSM, Amer. Stat. Assoc.) reported on progress
SAE Project Overview (cont.)

Over course of project, collaboration with BJS staff

Early results shared with BJS during development but not published

Fay, Planty, and Diallo (2013), Joint Statistical Meetings
SAE Project Outcomes

Dec. 17, 2015 – Technical report published on BJS website:


http://www.bjs.gov/index.cfm?ty=pbdetail&iid=5499

Web page includes links to the report and to Excel spreadsheets with the complete set of estimates

Methods documented in reports and software
Estimation Goals: Characteristics

Violent Crime by Type
• Rape and aggravated assault
• Robbery
• Simple assault

Violent Crime by Relationship to the Perpetrator
• Committed by intimate partner
• Committed by stranger(s)
• Committed by others
Estimation Goals: Characteristics (cont.)

Property Crime by Type

• Burglary
• Larceny
• Motor vehicle theft
Estimation Goals: Geographic Detail

• 50 states and the District of Columbia

• 65 large counties (with population above 800,000 in 2010)

• 51 large metropolitan areas (with population above 1,000,000 in 2010)
Estimation Goals: Time Period

• Estimates expressed as 3-year averages, e.g., 2011-2013
  • 3-year averages provide more stability
  • Direct estimates will be published for 3-year periods in boosted states (11 originally, 22 after 2015/2016 redesign)
  • 3- and 5-year period estimates from the American Community Survey (ACS) showed many data users could adapt to estimates in this form


SAE contrast with *direct estimates*

- Most surveys, including NCVS and other Federal surveys, primarily produce direct estimates

- Direct estimates typically based on relatively simple estimators applied to survey data files
  - Example: NCVS national estimates can be reproduced from public use files by outside researchers

- Direct estimates for an area/domain use data from the domain only

- Reliability of domain estimates depends directly on sample size within the domain
In contrast with direct estimates, small area estimates:

• First illustrated by application of Fay and Herriot (1979) to 1970 Census long-form data

• Are now produced for specific characteristics for some Federal surveys

• Use data from other domains or time periods to form estimate for each domain and time period

• Depend on implicit or explicit statistical models

• Can produce more reliable estimates for small areas, on average
Small Area Estimates 101 (cont.)

Small area estimates:

• Incorporate auxiliary data from external source(s)

• Can usually be produced for areas even if no sample is present from the survey
  • Example: NCVS sample design probably does not have sample in each state

• Typically less variable than direct estimates because sampling error is reduced – informally use term *smoothing*
Another inform term: *Borrowing strength*

Small area estimates are *indirect*. Schaible (1996) distinguished:

- *Domain indirect estimates* – borrow strength across domains
- *Time indirect estimates* – borrow strength across time within a domain
- *Domain and time indirect estimates* – borrow strength across both domains and time

The NCVS (SAE) estimates borrow strength over both across domains and over time
Summary of NCVS SAE Application

• Uses geographic information on Census Bureau’s internal NCVS files to compute direct estimates for states or other domains
• Auxiliary data from FBI Uniform Crime Reports (UCR) by type of crime: Forcible rape, robbery, burglary, larceny, motor vehicle theft
• Borrows strength across domains and time
• Like many SAE estimators, forms composite of prediction from model and direct estimates
Violent Crime, 2011-2013, NCVS vs. UCR, Fig. 2-1
Property Crime, 2011-13, NCVS vs. UCR, Fig. 2-2

NCVS (SAE) property crime rate, 2011-2013

UCR property crime rate, 2011-2013
Violent Crime 1999-2013, NCVS vs. UCR, Fig. 2-3
Property Crime 1999-2013, NCVS vs. UCR, Fig. 2-4

NCVS (SAE) property crime rate, 1999-2013

UCR property crime rate, 1999-2013
Rape and Aggravated Assault, NCVS vs. UCR, Fig. 2-9
Robbery 2011-2013, NCVS vs. UCR, Fig. 2-11
Simple Assault, 2011-2013 vs. 1999-2013, Fig. 2-13
Intimate partner violence, 2011-2013 vs. 1999-2013, Fig. 2-14
Violence by strangers, 2011-2013 vs. 1999-2013, Fig. 2-15
Violent Crimes in Massachusetts, 1999-2013, p. B-62
Violent Crimes in Massachusetts, 1999-2013, p. B-63
Assessing the NCVS (SAE) Estimates

• Because the NCVS (SAE) models borrow strength over time, the average of the SAE estimates over 15 years should look similar to the average of the direct estimates over 15 years.

• Special request to Disclosure Review Board to release 15 year average of NCVS direct estimates for states with population of 2 million or more in 2010.
Display of Results in Report, Fig. 2-5

NCVS (SAE) averages of violent crime rate, 1997-2011

NCVS direct averages of violent crime rate 1997-2011

Map showing the distribution of violent crime rates across the United States for the periods 1997-2011. The maps are color-coded to indicate different percentage ranges of violent crime rates compared to the national average, with specific states highlighted in various colors to reflect their relative crime rates.
Assessing the Estimates: RMSE Estimation

• RMSE errors are analogous to standard errors due to sampling, but they include the contribution of squared bias to the overall error.
• RMSE estimates are provided in the Excel spreadsheets for each of the SAE estimates.
• Large RMSE for very smallest states (< 1,000,000 pop):
  • Limited or no NCVS sample
  • Should treat results for these states as very uncertain – e.g., contrast between UCR and SAE estimates for upper plains states.
Remarks on Fit with BJS’s Overall Goals

• If updated, the SAE estimates may prove useful in analyzing the Low Cost Companion Survey in 40 CBSAs
• What systematic differences exist between the Low Cost and Core NCVS?
• Can consider methods to combine approaches
Using SAE Estimates

*Estimates are preliminary and subject to change.

Utility
Benchmarking – comparison of states to NCVS national estimates
Understanding the composition of crime within a state or MSA
Comparing crime rates in one state to crime rates in states that are similar in terms of key characteristics
Examining difference in crime trends between states
Assessing the impact of using victimization statistics for funding allocations
Comparing state victimization estimates to official police statistics - should be done with caution since UCR data is incorporated into models
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