INTERACTIONS BETWEEN SURVEY ESTIMATES AND FEDERAL FUNDING FORMULAS

Alan Zaslavsky, Harvard University
Allen Schirm, Mathematica Policy Research

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Reference

- Zaslavsky, Alan M. and Allen L. Schirm. "Interactions Between Survey Estimates and Federal Funding Formulas." *Journal of Official Statistics*, vol. 18, no. 3, September 2002, pp. 371-391.

Outline

1. Formulas
2. Data sources and estimation methods
3. Errors, interactions, and unintended consequences

Themes

- There are many tradeoffs
  - Political
  - Programmatic
  - Statistical
- Choices can have unintended consequences

Basic Features of Fund Allocation Programs

- Recipient units
- Frequency of allocations
- (Total allocation)

Components of Formulas

- Measures of
  - Need
  - Fiscal capacity
  - Effort

Need

- Potential measures
  - Number eligible
  - Percentage eligible
- Proportional allocation

Special Features of Formulas

- Thresholds
- Limits
- Hold-harmless provisions and caps
- Step functions
- Bonuses and penalties

Why Have Special Features?

- Promote efficient use of funds
- Stabilize funding
- Negotiate political compromise

Thresholds

- No allocation if below threshold
- Based on need
  - Number eligible
  - Percentage eligible
- Rationale
  - Minimum size to run program effectively
  - Focus assistance where need is greatest

Hold-Harmless Provisions

- Limit decrease in funding between periods
- Percentage of previous allocation
- Rationale: stability of funding
  - Political
  - Administrative
- With constant total appropriations, 100% hold-harmless implies fixed allocations

Data Sources for Estimating Formula Components

- Decennial census
  - Short-form
  - Long-form
- Intercensal population estimates
- Household surveys
  - Current Population Survey
  - American Community Survey
- Administrative records
- Other statistical programs

Methods for Estimating Formula Components

- Direct estimation
- Indirect estimation

Assessing Quality of Data Sources and Estimation Methods

- Conceptual fit
- Level of geographic detail
- Timeliness
- Statistical accuracy
  - Bias
  - Variance
- Susceptibility to manipulation
- Cost

Tradeoffs in Quality of Data Sources

- Decennial census
  - Sampling error negligible for some small areas, large for others
  - Long interval between updates
  - Limited content
- Household surveys
  - More current
  - More detailed content
  - Small samples for even "large" small areas

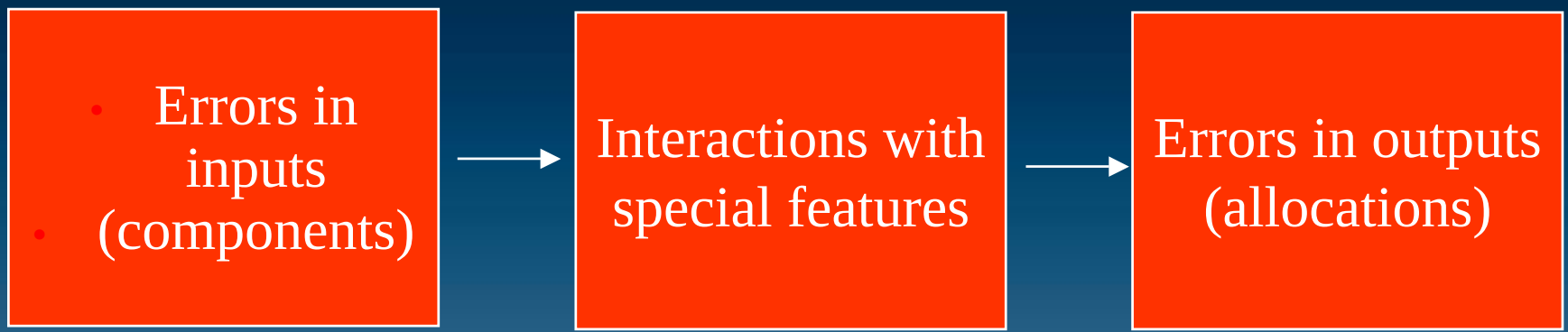
Tradeoffs in Quality of Data Sources

- Administrative data
  - Sampling error often negligible
  - Idiosyncratic content
  - Local variations
  - Practical challenges in obtaining and assembling

Introducing a New Data Source: The American Community Survey

- More current than decennial census
- Much bigger than other current household surveys—250,000 households/month
- Smaller than decennial census in one year—use moving averages
- Decennial census long-form content
- Full-scale implementation in 2005
- Replace decennial census long-form in 2010
- Political support still tenuous

Errors, Interactions, and Errors



How Formulas and Estimates Interact: General Findings

- Estimation method and formula are not entirely distinct.
- Example: Equivalence of
- – single year estimates as inputs to
- formula using moving average
- – moving average estimates as inputs to
- formula using single year

How Formulas and Estimates Interact: General Findings

- Allocations are "unbiased" over time if both estimation method and formula are linear.

How Formulas and Estimates Interact: Simulations

- Simulate estimates of need and resulting formula allocations under several scenarios.
- Evaluate by bias (mean allocation versus "correct" allocation).

Simulation Procedure

- Define true annual values.
- Simulate annual direct estimates by adding random (normal) noise.
- Apply estimation method.
- Apply formula over four-year period.
- Assume areas are independent.
- Repeat many times (~ 10,000 per scenario).

Factors Defining Scenarios

- Time pattern of true need
  - Constant
  - Upward Trend
  - Downward Trend
- Sampling standard error of estimates

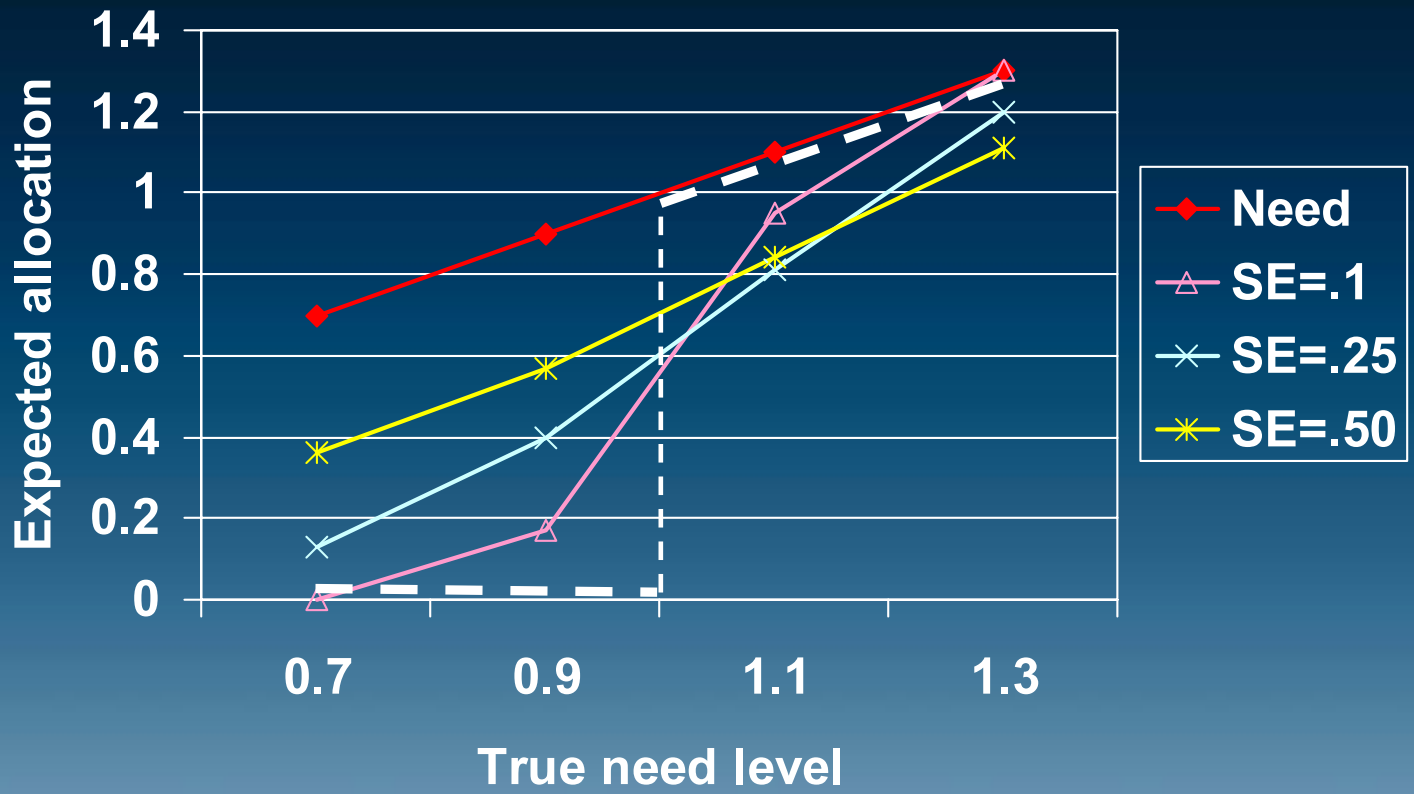
Factors Defining Scenarios

- Estimation method
  - Direct (single year)
  - 3-year moving average
  - 3-year exponentially weighted moving average (weights 1, .7, .49 at lags 0, 1, 2)
- Formula–allocation proportional to estimated need, possibly with
- – Hold harmless (at 80%)
- – Threshold (at 1)

Effect of Sampling Error When Have a Threshold

- Assume
  - Constant true values (.7, .9, 1.1, 1.3)
  - Various sampling SEs (.10, .25, .50, 1)
  - Single year estimation method
  - Threshold = 1

Effect of Sampling Error When Have a Threshold



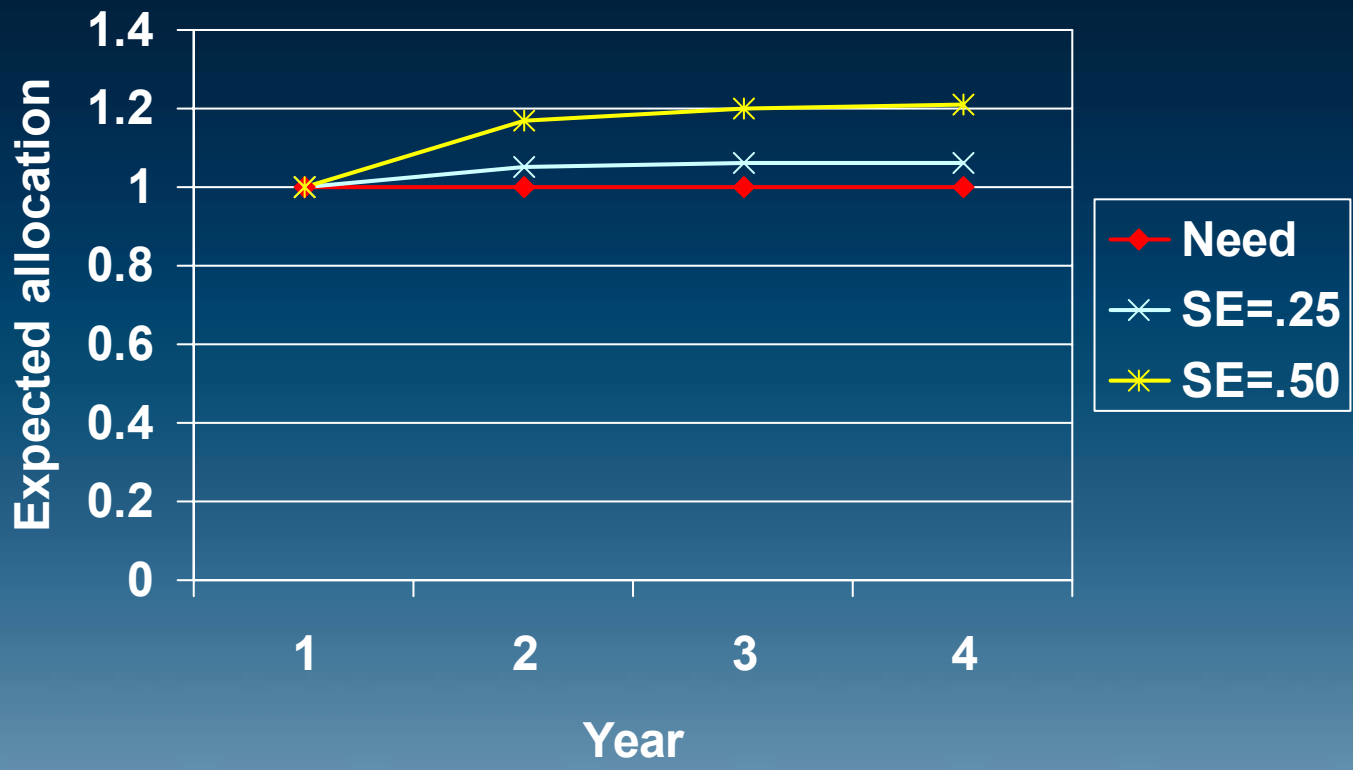
Effect of Sampling Error When Have a Threshold

- As sampling error falls, expected allocation approaches formula allocation based on true need (0 or true need).
- As sampling error grows, expected allocation line straightens out (smoothes out around the threshold). Threshold effect is lost.

Effect of Sampling Error When Have a Hold-Harmless Provision

- Assume
  - Constant true values (= 1)
  - Various sampling SEs (.10, .25, .50)
  - Three estimation methods
  - Hold Harmless = 80%

Effect of Sampling Error When Have a Hold-Harmless Provision



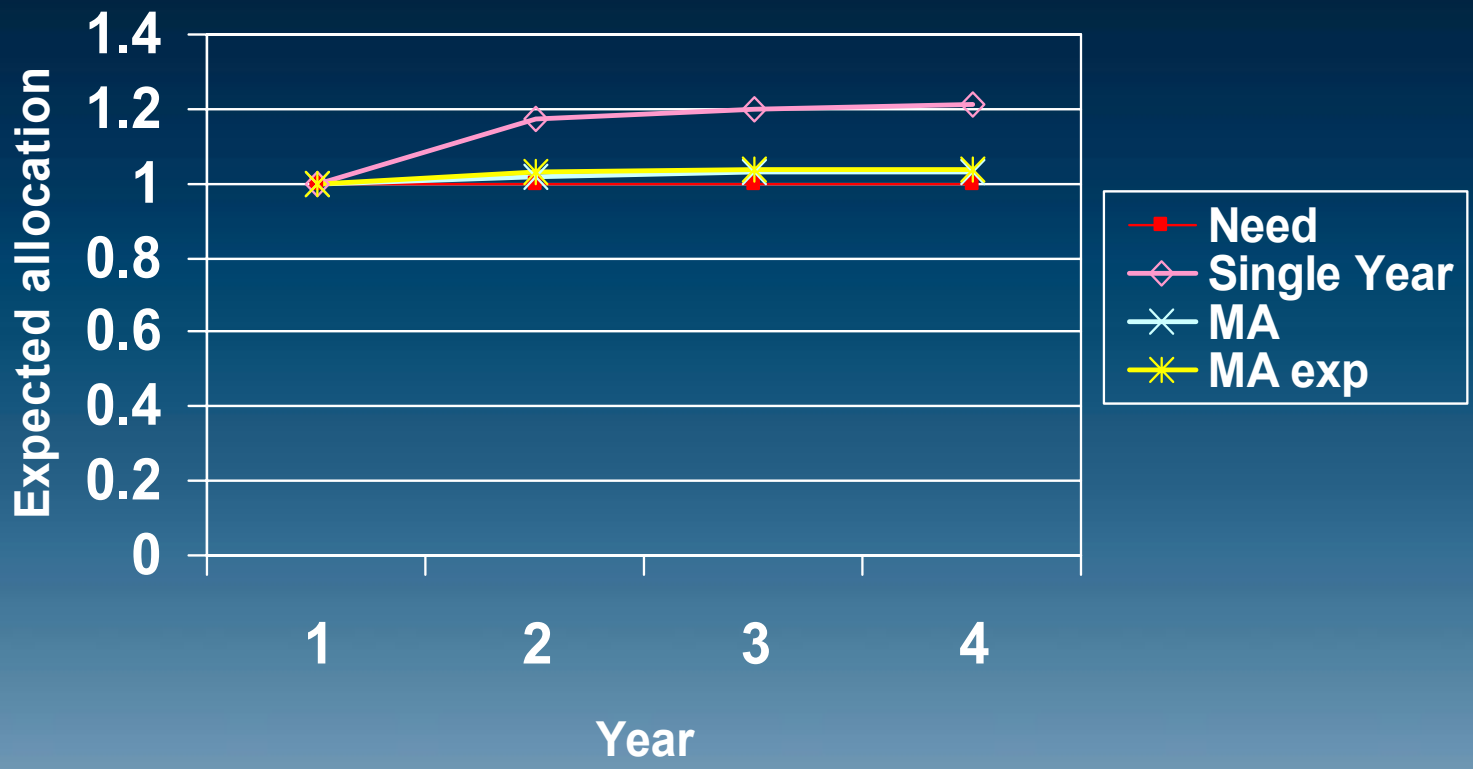
Effect of Sampling Error When Have a Hold-Harmless Provision

- With small sampling error, expected allocation is close to correct value.
- With large sampling error, expected allocation drifts above correct value and levels out.
- "Ratcheting" effect–up a lot, but down only a little

Modifiers of Hold-Harmless Bias

- Moving average estimation greatly reduces ratcheting effect.
- A threshold increases the ratcheting effect.

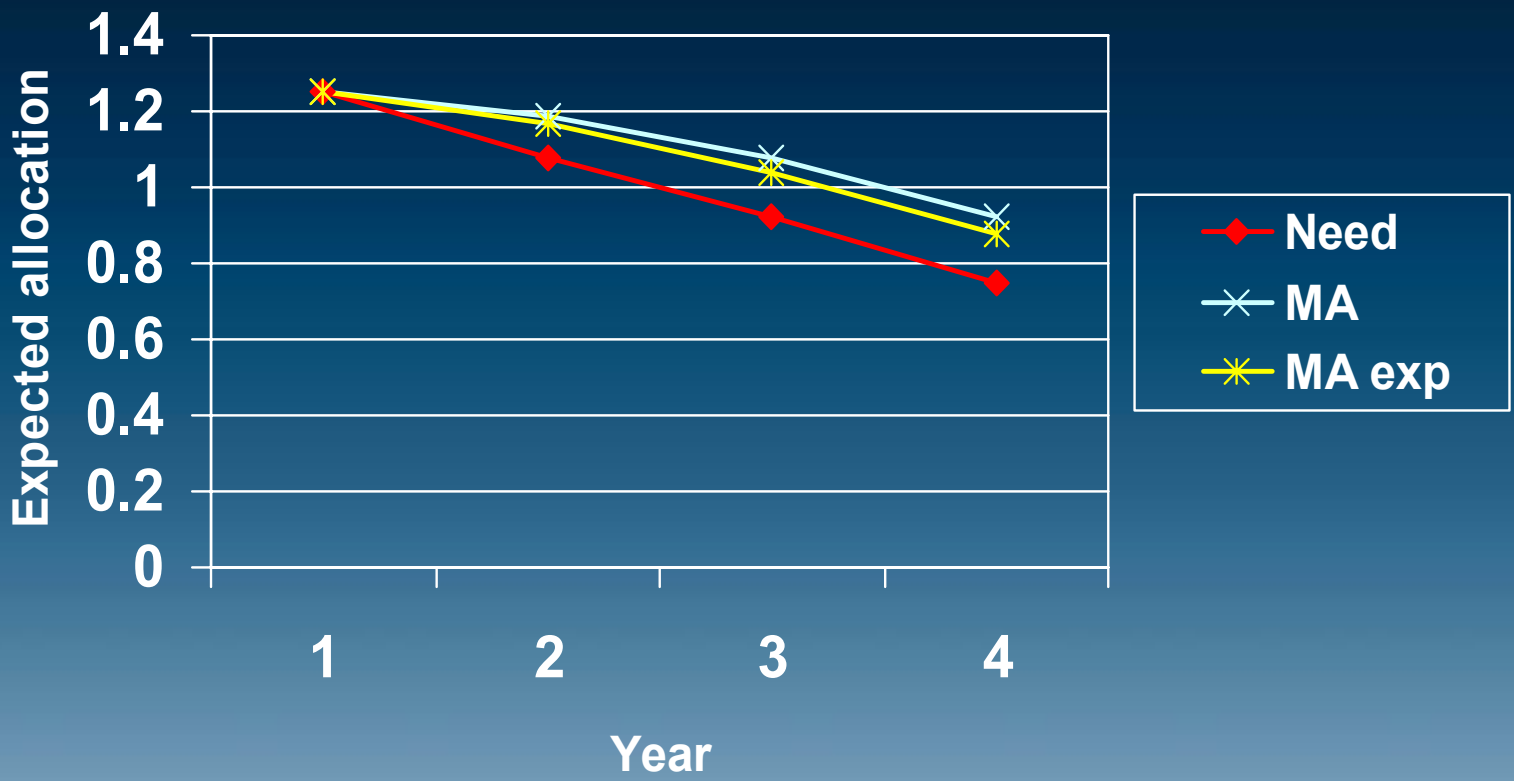
Effect of Moving Average Estimation



Effect of Moving Average Estimation When There Is a Trend

- Single-year estimates track correct value (in expectation)
- 3-year moving average falls behind trend
- 3-year exponentially-weighted moving average falls behind, but less so (for similar variance reduction)
- Optimal weighting (optimal bias-variance tradeoff) depends on autocorrelations of underlying time series

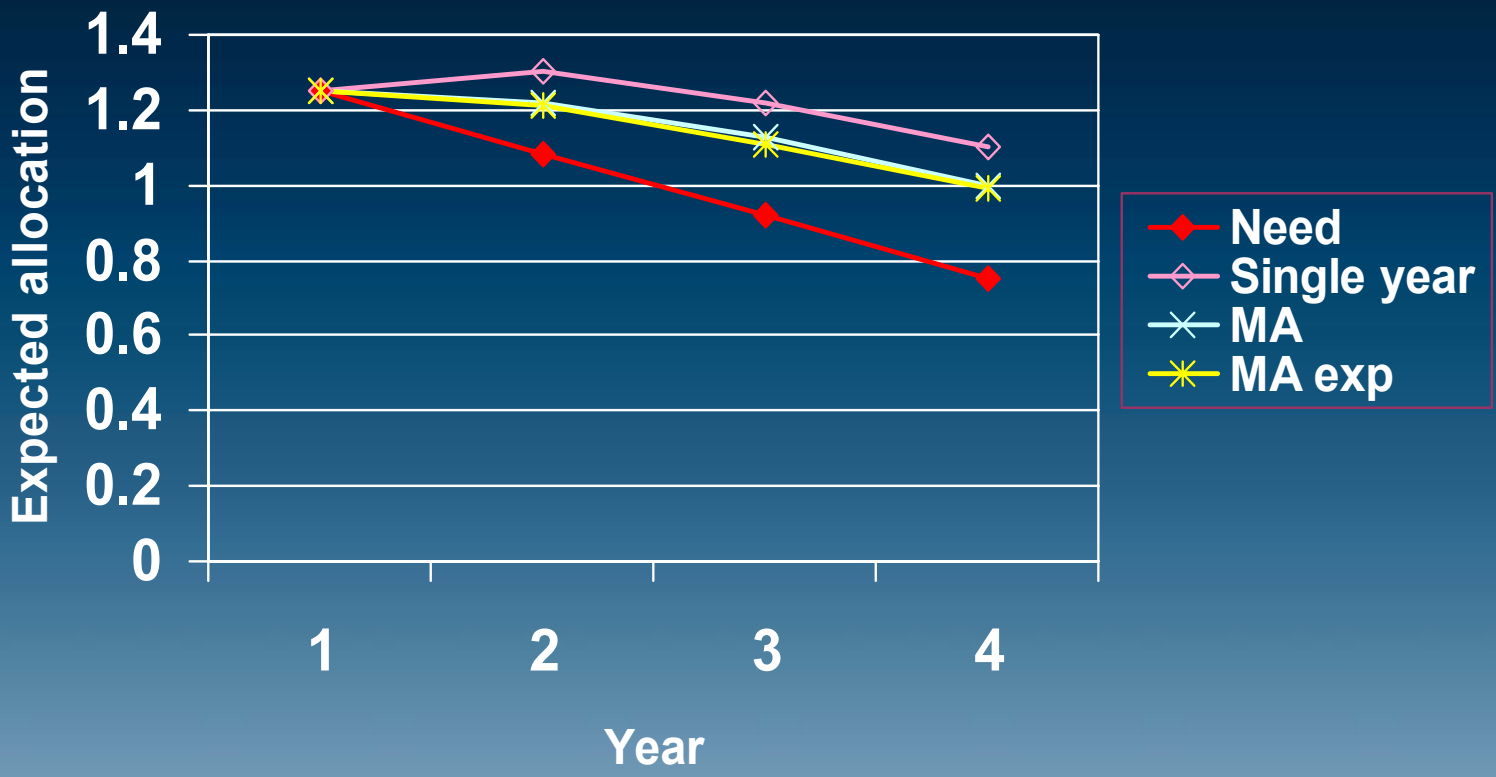
Effect of Moving Average Estimation When There Is a Trend



Effect of Hold-Harmless Provision When There Is a Trend

- Ratcheting effect depends on direction of trend
  - Decreased with upward trend
  - Increased with downward trend
- Moving average estimation reduces ratcheting effects

Effect of Hold-Harmless Provision When There Is a Trend



Stability with Hold-Harmless Versus Moving Average

- Assume
  - Constant true value (= 1)
  - Sampling SE = 0.5 or $0.5/\sqrt{3}$
  - Single year or MA3 estimation method
  - Hold Harmless = 80% or none

Stability with Hold-Harmless Versus Moving Average

Changes in Allocations from Year 3 to Year 4	Formula/Estimation Method		
	HH	HH(3)	MA(3) No HH
Fraction of changes down	0.624	0.576	0.500
Mean downward change	-0.236	-0.189	-0.188
Mean upward change	0.415	0.261	0.188

Stability with Hold-Harmless Versus Moving Average

- Downward changes no smaller with hold harmless
- Upward changes larger with hold harmless

Interactions and Unintended Consequences

- Larger distortion in allocations for smaller areas

Selected Recommendations

2. Conduct periodic evaluations of fund allocation performance at several points in time and over time (including before implementation).
   - Examine relationships between inputs and outputs
   - Identify misallocations and their causes
   - Assess tradeoff between stability of funding and responsiveness to changing need
   - Examine effects of special features
   - Assess tradeoffs pertaining to accuracy of estimates
   - Weigh costs and benefits of improving data sources and estimation methods

Selected Recommendations

3. Evaluate the effects of special features before implementation and on an on-going basis.
   - Consider a weaker hold-harmless provision or moving average estimation
   - Consider replacing a threshold by a smoother alternative

Selected Recommendations

4. Expand the use of simulations to evaluate fund allocation performance.
   - Focus on the effects of special features.
   - Conduct longitudinal analyses, examining the effects of changes in funding levels and need distributions.