Information from New Systems for Evaluating Survey Quality at EIA

For:

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Elizabeth E. Panarelli, Mathematical Statistician
U.S. Energy Information Administration
Office of Survey Development and Statistical Integration

Overview

- Introduction

- Concepts of Survey Quality

- Total Survey Error (TSE) Components

- Survey Data Life Cycle Framework

- Recommendations

- Summary

- For More Information

Introduction

- The U.S. Energy Information Administration (EIA) applies a flexible framework for evaluating the quality of the design and administration for each survey.
    - EIA uses established statistical methods in evaluating survey quality.
    - EIA's quality approach is tailored to establishment surveys, which comprise the vast majority of EIA's data collection instruments.
    - The nature of the survey quality evaluation process is often influenced by the capabilities of supporting systems and staff resources.

- An EIA initiative to consolidate and standardize survey systems presents an opportunity to provide more data from the new systems to enhance the evaluation of survey quality.

Introduction (Continued)

- Practical, high level data needs for evaluating survey quality are presented.

    – The data recommendations are mapped to a Total Survey Error (TSE) classification over a high-level view of the EIA survey data life cycle.

    – Any approach to evaluating survey quality must recognize that:

        - Some measures of survey quality are more qualitative than quantitative.

        - Sources of non-sampling error are difficult to identify and quantify.

        - Complete population data may not be known to enable effective use of theoretically precise formulae to evaluate sampling, estimation and imputation methods.

        - Efforts to improve quality in one area may involve trade-offs in other areas.

Introduction (Continued)

- A "total survey quality" approach to evaluating survey design and administration is not presented

  – The focus of this presentation is on systems data needs and not on ways to identify and respond to the all the data needs that internal and external survey users may have.

Concepts of Survey Quality

- Generally, total survey quality involves maximizing the quality of survey design and the administration of surveys while also responding to survey users' needs.

- Bias and variance measures are commonly used to evaluate survey design quality.

- The Total Survey Error (TSE) Concept
  - The term, "Total Survey Error" was coined by Anderson, Kasper, and Frankel in a 1979 book of the same title; More recently, Robert Groves and others have published research on TSE.
  - TSE provides a framework for maximizing user-specified dimensions of quality in survey design (Biemer 2010).
  - Major sources of error should be identified to allocate resources to reducing their errors while meeting cost and timeliness objectives (Biemer 2010).

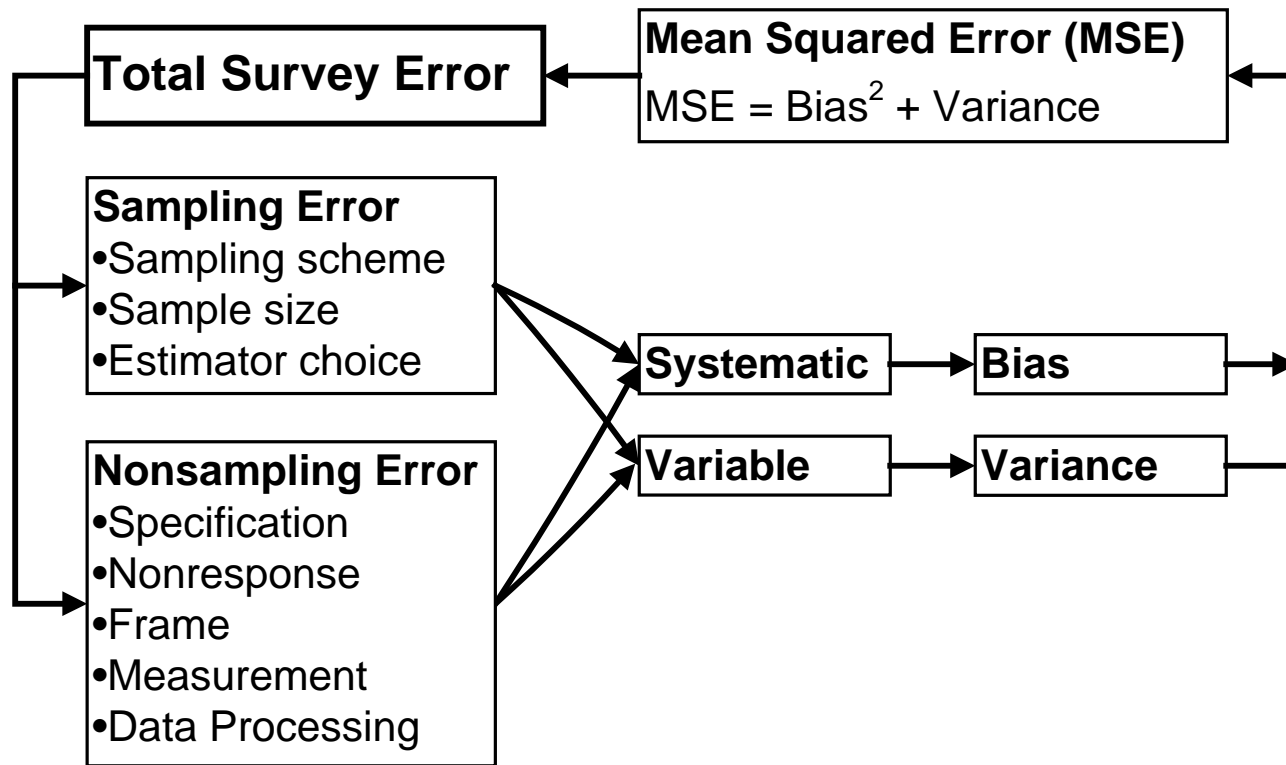# Total Survey Error (TSE) Components

Figure 1: Total Survey Error, Its Components, and the Mean Squared Error (Biemer 2010)
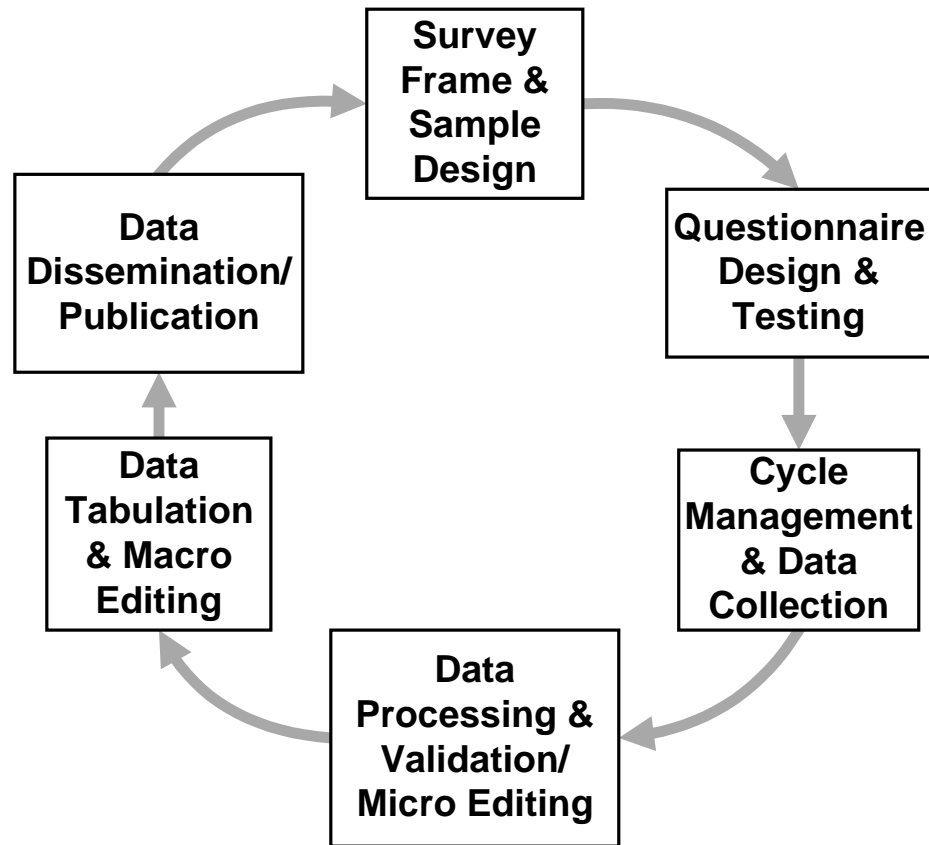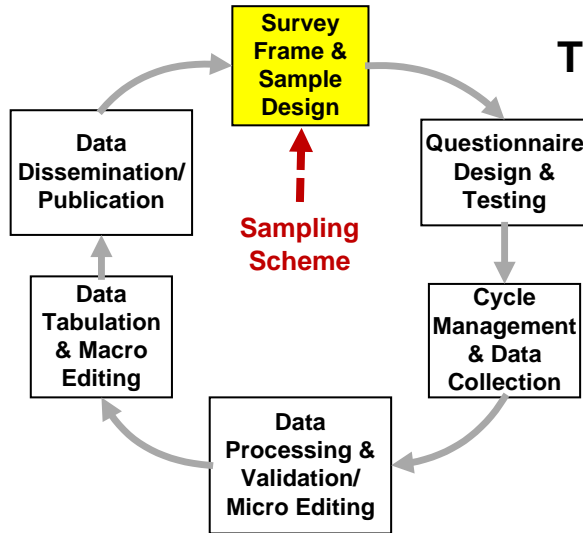
Survey Data Life Cycle Framework

Figure 2: Typical EIA Survey Data Life Cycle (High Level)

Recommendations

TSE Sources of Sampling Error

- **Sampling Scheme:**
  - Cut-off designs are predominant in establishment surveys; probability proportional to size (PPS) and other random designs are also used.
  - Any stratification is typically done by the size of the variable of interest and/or the geographic origin or destination of the variables of interest, including administrative data and questionnaire response values.

- **System Capabilities for Evaluating TSE:**
  - Provide data values for sampling the variables of interest at the respondent level.
  - Enable evaluating sample schemes though periodic censuses (if possible) or the calculation of sampling metrics, such as sampling variance.

Recommendations

TSE Sources of Sampling Error (Continued)
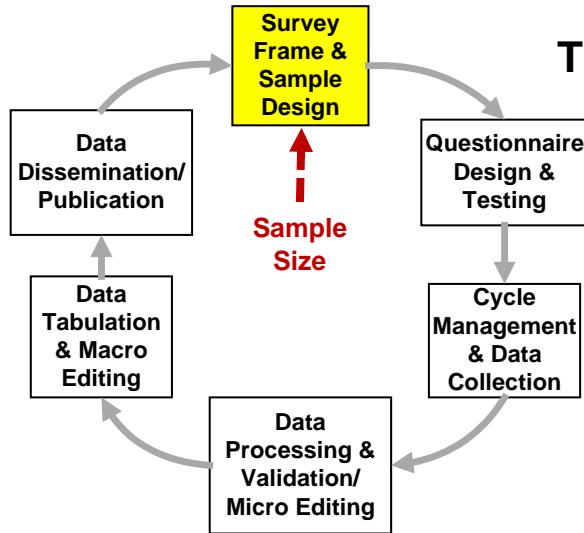
- **Sample Size:**
  - Samples generally are designed to insure that 1) high percentages of each of the values of published summary level data are captured, 2) the standard deviations or variance of sample response values are minimized, and 3) the samples are not biased.

- **System Capabilities for Evaluating TSE:**
  - Identify respondents in the frame as either being active or inactive for any given survey cycle.
  - Enable a historical review of respondent births, deaths, mergers and name changes in the survey frame.
  - Provide the ability to measure the number of editing and imputation changes to response values by questionnaire item.

Recommendations (continued)

TSE Sources of Sampling Error (Continued)
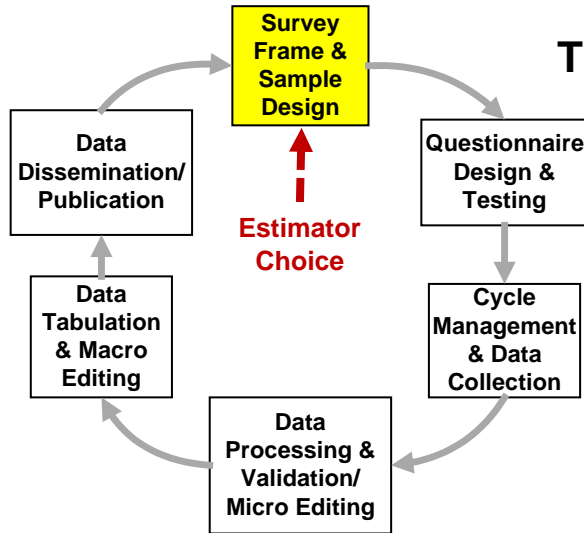
- **Estimator Choice:**
    - Estimation typically involves ratio or regression formulas.
    - Summary level data is often presented by geographical groupings.

- **System Capabilities for Evaluating TSE:**
    - Indicate which 'final' historical data were reported by respondents (as opposed to being imputed) to enable excluding imputed values from estimates.
    - Identify 'new' respondents for a period of time to permit evaluating the quality of their new responses.

Recommendations (continued)

**TSE Sources of Sampling Error (Continued)**
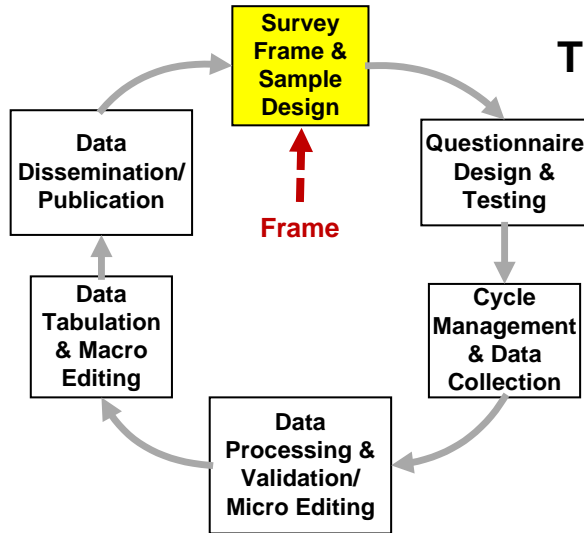
- **Frame Error:**
  - Frame error is primarily caused by frame omissions that lead to frame non-coverage errors, frame duplicates, failure to account for mergers and acquisitions, and the inclusion of entities that are not part of the target population.

- **System Capabilities for Evaluating TSE:**
  - Identify potential duplicate frame entries.
  - Identify all active and inactive respondents for specific survey cycles.
  - Enable a historical review of respondent births, deaths, mergers and name changes in the survey frame.

Recommendations (continued)

TSE Sources of Non-Sampling Error (Continued)
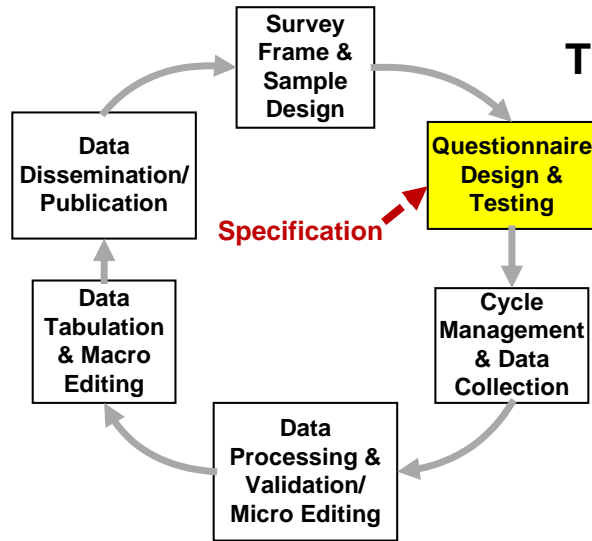
- **Specification Error:**
  - Is often identified through interviews of survey respondents
  - Is addressed by applying cognitive survey design best practices

- **System Capabilities for Evaluating TSE:**
  - Associate data validation rules/edits with specific questions on surveys.
  - Collect paradata to determine patterns regarding the failure of validation rules/edits.
  - Calculate edit failure rates for questions and the rates of changes to the response values of survey questions.

Recommendations (continued)

Survey Frame & Sample Design → Questionnaire Design & Testing (Measurement) → Cycle Management & Data Collection → Data Processing & Validation/ Micro Editing → Data Tabulation & Macro Editing → Data Dissemination/ Publication

TSE Sources of Non-Sampling Error (Continued)
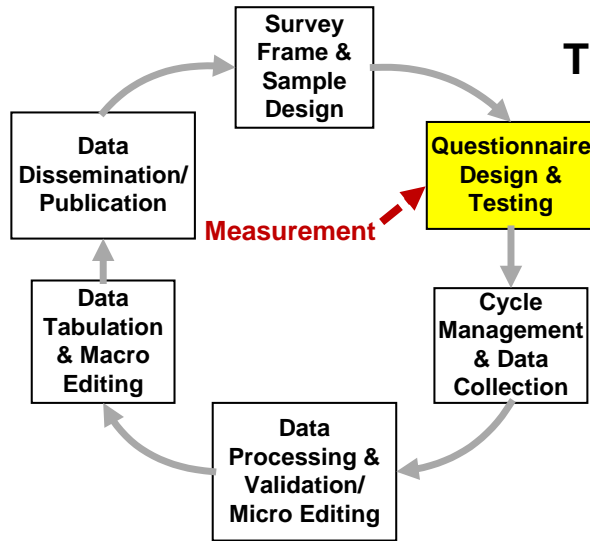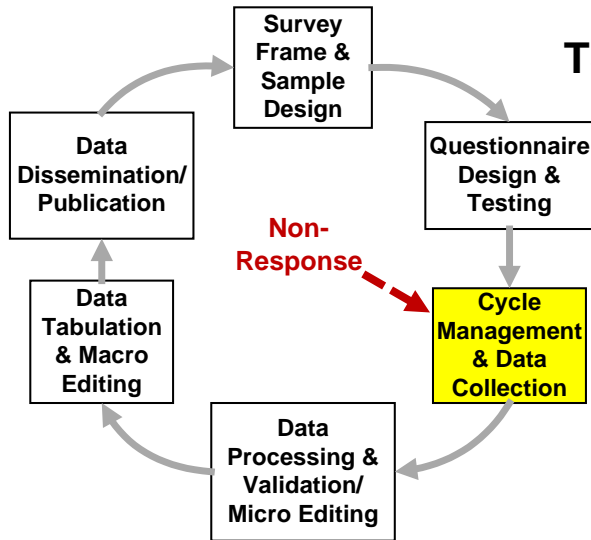
- **Measurement Error:**
    - Is often identified through interviews of survey respondents
    - Is addressed by applying cognitive survey design best practices

- **System Capabilities for Evaluating TSE:**
    - Apply data validation rules that detect measurement errors, such as evaluating against expected response values.
    - Integrate the investigation of potential errors with respondent contact management systems.
    - Avoid running imputed data, and re-cycling unchanged data, through the editing process.

Recommendations

Survey Frame & Sample Design → Questionnaire Design & Testing → Cycle Management & Data Collection → Data Processing & Validation/ Micro Editing → Data Tabulation & Macro Editing → Data Dissemination/ Publication
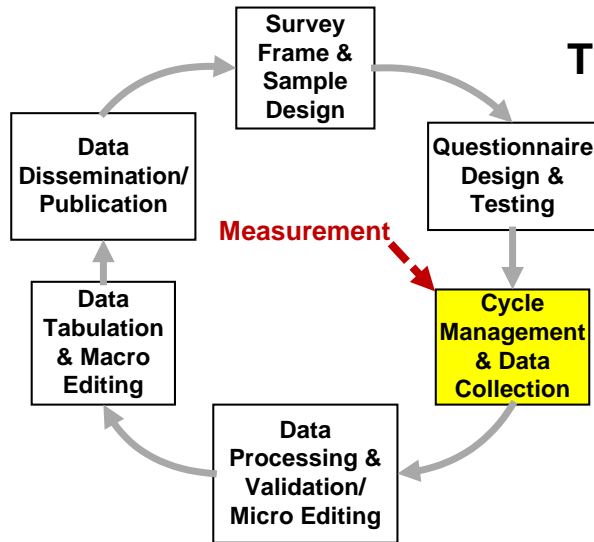
Non-Response

TSE Sources of Non-Sampling Error (Continued)

- **Non-Response Error:**
  - Many methods exist for identifying and categorizing unit and item non-response errors.

- **System Capabilities for Evaluating TSE:**
  - Identify unit and item non-responses at different times during each survey cycle.
  - Identify the total expected unit and item responses, based on respondent and response eligibility.
  - Integrate respondent contact management systems with the investigation of item and unit non-responses.
  - Track the responses that were eventually obtained from the non-response investigation process.

Recommendations

TSE Sources of Non-Sampling Error (Continued)

- **Measurement Error:**
  - An example of a source of measurement error at this stage is a survey interviewer incorrectly transcribing or biasing the question response value.

- **System Capabilities for Evaluating TSE:**
  - Tie survey responses to individual interviewers who collected and transcribed the data.
  - Note that if interviewers are provided by third parties, those firms likely monitor measurement error from interviewers, along with other interviewer performance metrics.

Recommendations

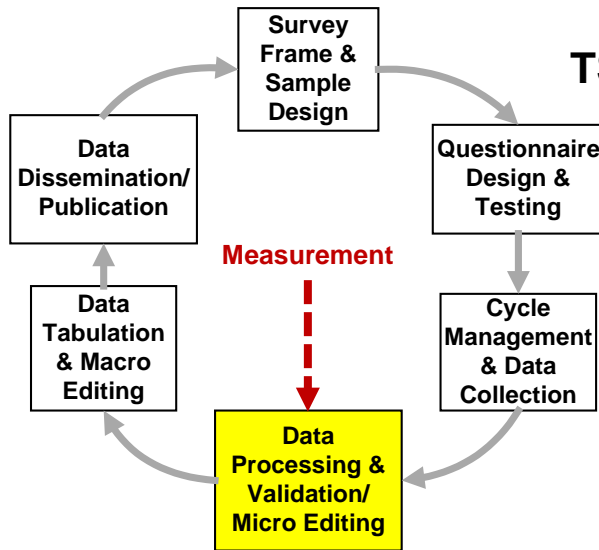**TSE Sources of Non-Sampling Error (Continued)**
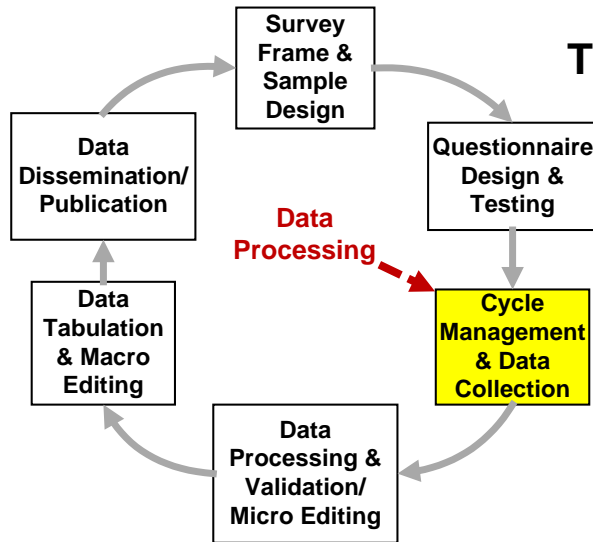
- **Data Processing Error:**
  - Typically, data processing errors occur when survey staff make mistakes manually entering (re-keying) and coding respondent data.

- **System Capabilities for Evaluating TSE:**
  - Maintain copies of survey responses that were not directly inputed to survey data collection systems.
  - Identify the collected data that was re-keyed by survey staff for comparison with the data sources.
  - Identify the staff members who re-keyed specific response values or who performed specific coding.
  - Enable the review of automatic response coding algorithms.

Recommendations

Survey Frame & Sample Design → **Questionnaire Design & Testing** → **Cycle Management & Data Collection** → **Data Processing & Validation/ Micro Editing** → **Data Tabulation & Macro Editing** → **Data Dissemination/ Publication**

Measurement (pointing to Data Processing & Validation/ Micro Editing)

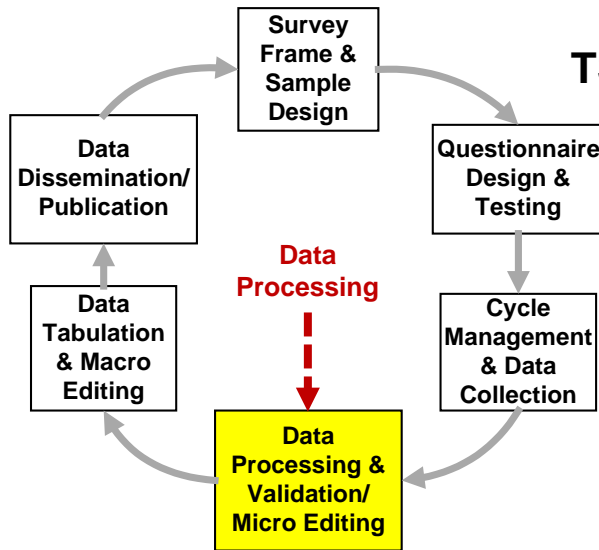## TSE Sources of Non-Sampling Error (Continued)

- **Measurement Error:**
  - The respondent applies an incorrect unit of measure to their item response values.
  - A survey analyst biases how a response value is either changed or not changed by the respondent.

- **System Capabilities for Evaluating TSE:**
  - Apply edits that detect unit of measure errors.
  - Identify response values changed by survey staff and the associated reasons for the changes.
  - Provide paradata to identify any patterns in response values following investigations by survey staff of potential errors or following any change initiated by the respondent.

Recommendations

Survey Frame & Sample Design → Questionnaire Design & Testing → Cycle Management & Data Collection → Data Processing & Validation/ Micro Editing → Data Tabulation & Macro Editing → Data Dissemination/ Publication

Data Processing

TSE Sources of Non-Sampling Error (Continued)

- **Data Processing Error:**
    - Includes errors in specifying data validation rules/edits and failure to investigate potential errors in item response values

- **System Capabilities for Evaluating TSE:**
    - Provide reports that detail active and inactive edits.
    - Require survey staff comments and/or reason codes for error investigation.
    - Collect paradata to identify the data validation rules/edits that do not result in high rates of the detection of 'true' errors.
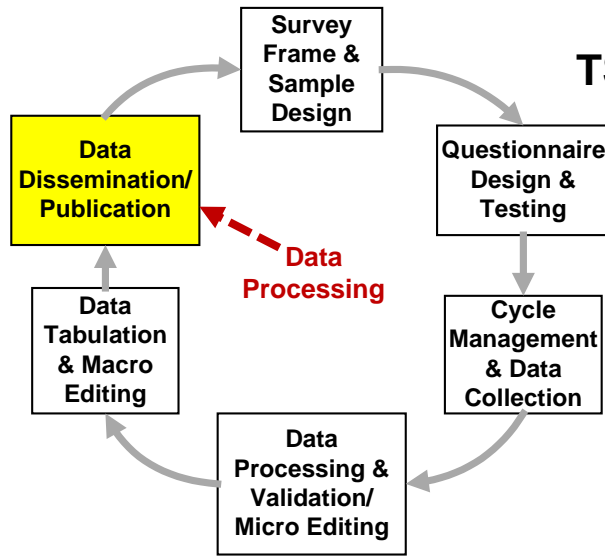
Recommendations
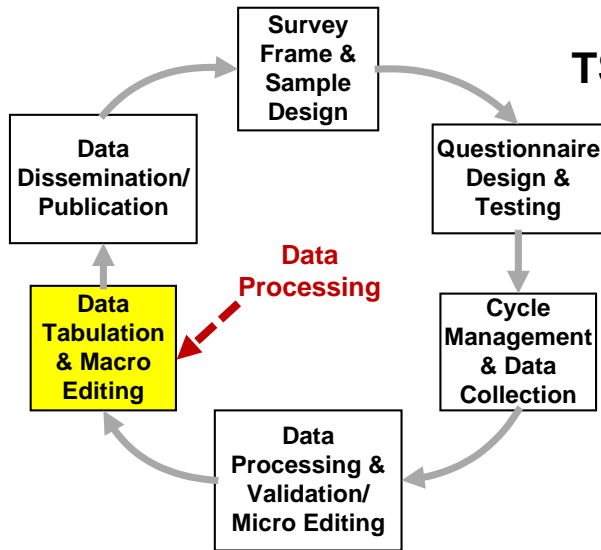
TSE Sources of Non-Sampling Error (Continued)

- **Data Processing Error:**
  - Errors in applying estimation, data suppression, and tabulation formulas to produce information that is in its publication-ready form

- **System Capabilities for Evaluating TSE:**
  - Maintain an 'audit trail' of all transformations of item response data values (i.e., from 'raw' to 'final' values).
  - Apply macro-editing to identify unexpected data trends in published data groupings.
  - Trace backwards from the published data groupings to the underlying data values.

Recommendations

Survey Frame & Sample Design → Questionnaire Design & Testing → Cycle Management & Data Collection → Data Processing & Validation/ Micro Editing → Data Tabulation & Macro Editing → Data Dissemination/ Publication

Data Processing

TSE Sources of Non-Sampling Error (Continued)

- **Data Processing Error:**
  - Published data values do not match the associated tabulation values in feeder files.

- **System Capabilities for Evaluating TSE:**
  - Track the processing status and completeness of any data sources that feed the publications.
  - Enable tracking data values from the published statistics through data processing and back to the raw data values that were initially collected.

Summary

- Educate the entire organization about the importance of evaluating the quality of survey design and administration.

- Incorporate in new systems requirements the ability to gather data for the evaluation of quality for survey design and administration.

- Generate within software systems an audit trail of all changes to data values from each system process.

For More Information

Atrostic, B.K., and Kalenkoski, Charlene. (2002). "Item Response Rates: One Indicator of How Well We Measure Income." *Proceedings of the American Statistical Association, Survey Research Methods Section* (www.amstat.org/sections/SRMS/Proceedings)

– Provides information about identifying item non-responses (Slide 15).

Biemer, Paul, et. Al. (2012). "A Tool for Managing Product Quality: the Case of Statistics Sweden." European Conference on Quality in Official Statistics (Q2012), Managing Quality – Products Session (http://www.q2012.gr/articlefiles/sessions/3.2_Biemer_Presentation%20%20_A%20Tool%20for%20Managing%20Product%20Quality_Biemer_Bergdahl.pdf)

– Provides information about recent efforts to apply a 'dashboard' approach to evaluating Total Survey Error (TSE), as referenced in the notes page of Slide 7

For More Information (Continued)

Biemer, Paul. (2010). "Total Survey Error: Design, Implementation, and Evaluation." *Public Opinion Quarterly*, Vol. 74, No. 5, pp. 817–848.

– Provides information about the TSE framework and its components, as referenced from Slides 9 through 21.

Ireland Centralized Statistics Office. (2000). "Editing and Calibration in Survey Processing." (http://www.cso.ie/en/surveysandmethodology/generalmethodologydocuments/editingandcalibrationinsurveyprocessing/)

– Provides a case study of the application of macro-editing, as referenced in Slide 20, and Micro-Editing, as referenced in Slides 14 through 19.

Yorgason, Daniel, et. al. (2011). "Cutoff Sampling in Federal Surveys: An Inter-Agency Review." *American Statistical Association, Joint Statistical Meetings, Section on Government Statistics* (www.bls.gov/osmr/pdf/st110050.pdf)

– Provides information as to how a number of federal statistical agencies are using cut-off sampling in their establishment surveys, as referenced in Slide 9.

Thank You!

Elizabeth (Liz) E. Panarelli, Mathematical Statistician

U.S. Energy Information Administration (EIA)

elizabeth.panarelli@eia.gov

(202) 586-2234