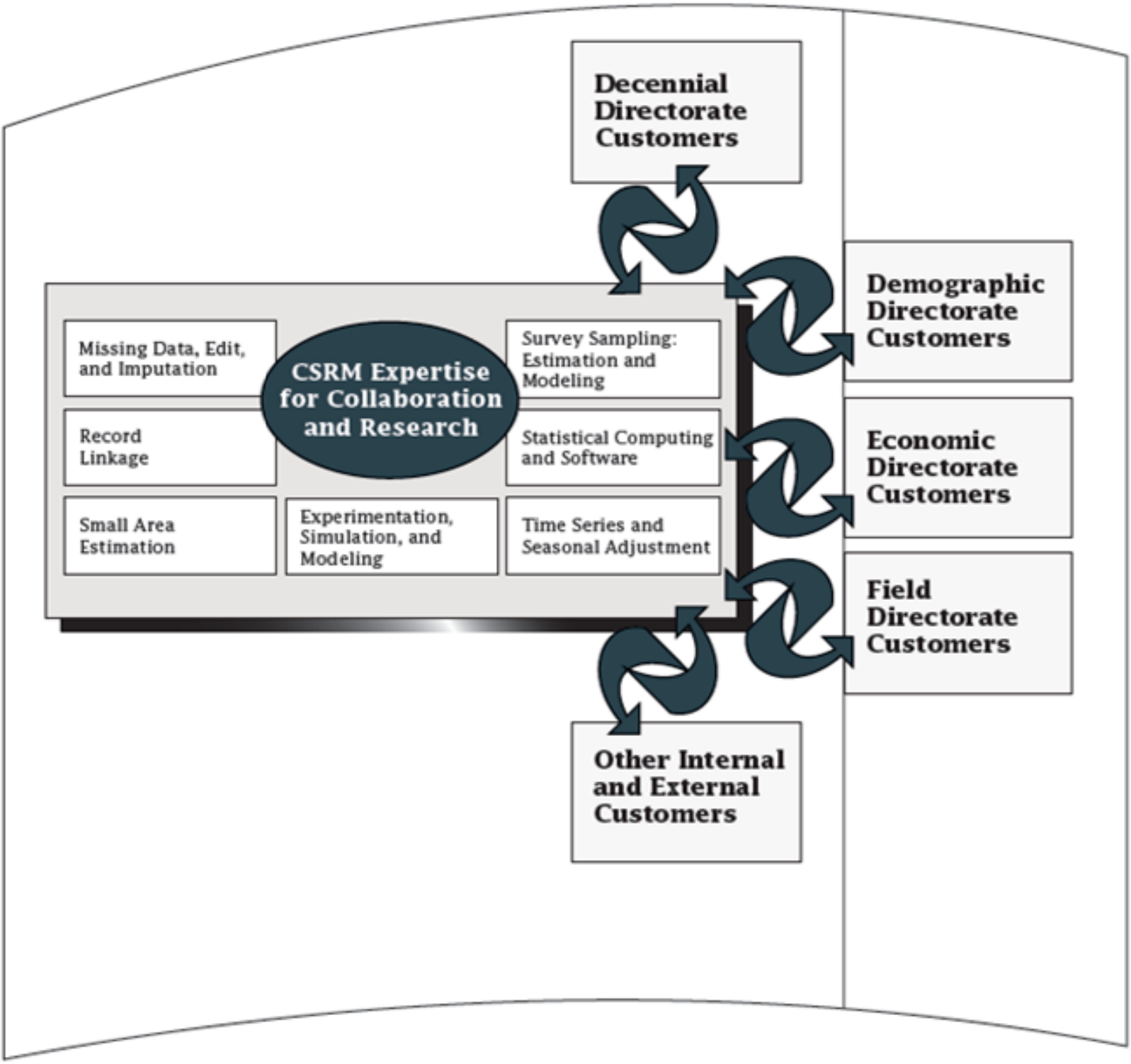
Annual Report *of the* Center for Statistical Research and Methodology

Research and Methodology Directorate

Fiscal Year 2013



U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU

United States Census Bureau

Since August 1, 1933—

"... As the major figures from the American Statistical Association (ASA), Social Science Research Council, and new Roosevelt academic advisors discussed the statistical needs of the nation in the spring of 1933, it became clear that the new programs—in particular the National Recovery Administration—would require substantial amounts of data and coordination among statistical programs. Thus in June of 1933, the ASA and the Social Science Research Council officially created the Committee on Government Statistics and Information Services (COGSIS) to serve the statistical needs of the Agriculture, Commerce, Labor, and Interior departments ... COGSIS set ... goals in the field of federal statistics ... (It) wanted new statistical programs—for example, to measure unemployment and address the needs of the unemployed ... (It) wanted a coordinating agency to oversee all statistical programs, and (it) wanted to see statistical research and experimentation organized within the federal government ... In August 1933 Stuart A. Rice, President of the ASA and acting chair of COGSIS, ... (became) assistant director of the (Census) Bureau. Joseph Hill (who had been at the Census Bureau since 1900 and who provided the concepts and early theory for what is now the methodology for apportioning the seats in the U.S. House of Representatives) ... became the head of the new Division of Statistical Research ... Hill could use his considerable expertise to achieve (a) COGSIS goal: the creation of a research arm within the Bureau ..."

Source: Anderson, M. (1988), *The American Census: A Social History,* New Haven: Yale University Press.

Among others and since August 1, 1933, the Statistical Research Division has been a key catalyst for improvements in census taking and sample survey methodology through research at the U.S. Census Bureau. The introduction of major themes for some of this methodological research and development where staff of the Statistical Research Division[1] played significant roles began roughly as noted—

- **Early Years (1933–1960s):** *sampling (measurement of unemployment and 1940 Census); probability sampling theory; nonsampling error research; computing; and data capture.*
- **1960s–1980s:** *self-enumeration; social and behavioral sciences (questionnaire design, measurement error, interviewer selection and training, nonresponse, etc.); undercount measurement, especially at small levels of geography; time series; and seasonal adjustment.*
- **1980s–Early 1990s:** *undercount measurement and adjustment; ethnography; record linkage; and confidentiality and disclosure avoidance.*
- **Mid 1990s–Present:** *small area estimation; missing data and imputation; usability (human-computer interaction); and linguistics, languages, and translations.*

At the beginning of FY 2011, most of the Statistical Research Division became known as the Center for Statistical Research and Methodology. In particular, with the establishment of the Research and Methodology Directorate, the Center for Survey Measurement and the Center for Disclosure Avoidance Research were separated from the Statistical Research Division, and the remaining unit's name became the Center for Statistical Research and Methodology.

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[1]The Research Center for Measurement Methods joined the Statistical Research Division in 1980. In addition to a strong interest in sampling and estimation methodology, research largely carried out by mathematical statisticians, the division also has a long tradition of nonsampling error research, largely led by social scientists. Until the late 1970s, research in this domain (e.g., questionnaire design, measurement error, interviewer selection and training, nonresponse, etc.) was carried out in the division's Response Research Staff. Around 1979 this staff split off from the division and became the Center for Human Factors Research. The new center underwent two name changes—first, to the Center for Social Science Research in 1980, and then, in 1983, to the Center for Survey Methods Research before rejoining the division in 1994.

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We help the Census Bureau improve its processes and products. For fiscal year 2013, this report is an accounting of our work and our results.

Center for Statistical Research & Methodology

Highlights of What We Did...

As a technical resource for the Census Bureau, each researcher in our center is asked to do three things: *collaboration/consulting*, *research*, and *professional activities and development*. We serve as members on teams for a variety of projects and/or subprojects.

Highlights of a selected sampling of the many activities and results in which the Center for Statistical Research and Methodology staff members made contributions during FY 2013 follow, and more details are provided within subsequent pages of this report:

- *Missing Data, Edit, and Imputation*: (1) developed models for the evaluation of field productivity in the ACS; (2) imputed food stamps benefits (SNAP) for "missing waves" using multiple linear regression recursively to "sandwich" imputations missing waves; (3) investigated ACS CATI and CAPI paradata to assess the current contact strategy; and (4) researched approaches for determining "good" administrative records for the 2020 Census.

- *Record Linkage:* (1) provided very extensive advice, documentation, and software to the 2020 Matching Group; (2) documented and re-tested approximately thirty software programs for use by the Error-Rate Estimation Subgroup; and (3) provided extensive advice and software related to name and address standardization.

- *Small Area Estimation*: (1) developed an empirically based small sample adjustment for first order approximations to the uncertainty in replicate weight variance estimates for use in small area models of design-based variances; (2) combined data from the American Community Survey and Survey of Income and Program Participation to model estimates of disability at the state level; and (3) conducted a simulation study to evaluate which model framework produces better confidence intervals for small rates (near 0%) when the sample size is small.

- *Survey Sampling-Estimation and Modeling*: (1) developed a single-stage optimization-based weighting-adjustment methodology that could replace the first five stages of CPS weighting and made preliminary comparisons of the effects of the changes vs. 2012 CPS weights; (2) developed methodology for implementing an M-estimation algorithm for detecting and treating influential values in economic surveys that is technically rigorous and conservative in terms of minimal false detections; and (3) analyzed ACS CATI data to inform adaptive policy changes in curtailing numbers of possible CATI contact attempts to minimize respondent burden with minimal loss of completed interviews.

- *Statistical Computing and Software*: (1) developed new procedures in *Tea* for sparse-table raking, sequential regression imputation, and ratio imputation; (2) developed flexible Fortran and R functions for Bayesian hierarchical modeling and penalized spline regression, with application to National Crime Victimization Survey; and (3) implemented an experimental longitudinal imputation procedure for Monthly Wholesale Trade Survey.

- *Time Series and Seasonal Adjustment*: (1) developed formulas and results for fitting and forecasting from parameter constrained vector autoregressive models, and also completed implementations of classical and Bayesian estimation procedures for such models, such that the parameterization ensures stability and stationarity; (2) revised the *X-13ARIMA-SEATS* several times, and the version of *SEATS* incorporated into the software was updated. Enhancements developed include new regressors which for quadratic ramp variables and sequence outlier regressors, allow users to specify a probability level for critical values for AIC testing of regression variables. This version was released to the public after testing by the Economic Directorate; and (3) developed, encoded, and evaluated methodology for multivariate seasonal adjustment utilizing latent dynamic factor models for unobserved components.

- *Experimentation, Simulation, and Modeling:* (1) developed an approach for setting ratio edit tolerances by using statistical tolerance intervals; (2) provided a power and sample size analysis for an adaptive design contact strategy; (3) identified zero-inflated models as an appropriate strategy for modeling the coverage errors of the Master Address File (MAF); and (4) informed the sample design for MAF Error Model (MEM) Validation Test.

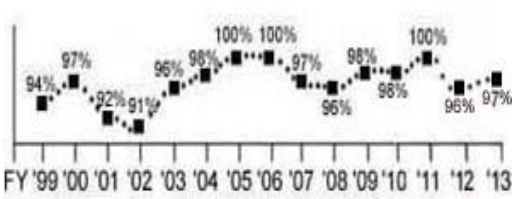
- *SUMMER AT CENSUS:* Sponsored, with divisions around the Census Bureau, scholarly, short-term visits by 28 researchers/leaders who collaborated extensively with us and presented seminars on their research. For a list of the 2013 *SUMMER AT CENSUS* scholars, see *http://www.census.gov/research/summer_at_census/ summer_2013.php*.

How Did We[1] Do...

For the 15th year, we received feedback from our sponsors. Near the end of fiscal year 2013, our efforts on 30 of our program (Decennial, Demographic, Economic, External) sponsored projects/subprojects with substantial activity and progress and sponsor feedback (Appendix A) were measured by use of a Project Performance Measurement Questionnaire (Appendix B). Responses to all 30 questionnaires were obtained with the following results (The graph associated with each measure shows the performance measure over the last 15 fiscal years):

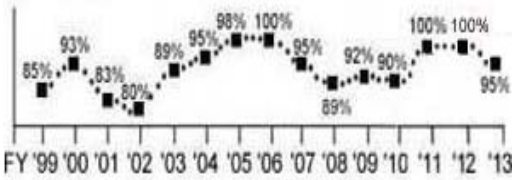
Measure 1. Overall, Work Met Expectations

Percent of FY2013 Program Sponsored Projects/Subprojects where sponsors reported that overall work met their expectations (agree or strongly agree) (29 out of 30) …….……..... 97%



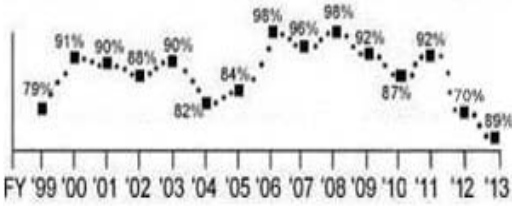
Measure 2. Established Major Deadlines Met

Percent of FY2013 Program Sponsored Projects/Subprojects where sponsors reported that all established major deadlines were met (19 out of 20 responses) ……....…….. 95%



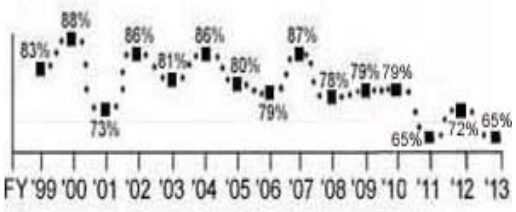
Measure 3a. At Least One Improved Method, Developed Technique , Solution, or New Insight

Percent of FY2013 Program Sponsored Projects/Subprojects reporting at least one improved method, developed technique, solution, or new insight (17 out of 29 responses) …… 59%



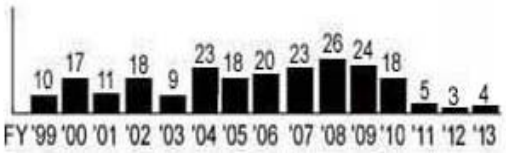
Measure 3b. Plans for Implementation

Of these FY2013 Program Sponsored Projects/Subprojects reporting at least one improved method, technique developed, solution, or new insight, the percent with plans for implementation (11 out of 17 responses) …….. 65%



Measure 4. Predict Cost Efficiencies

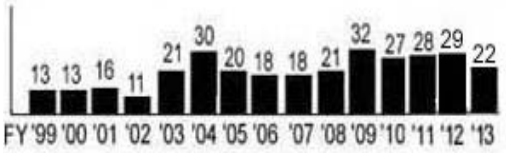
Number of FY2013 Program Sponsored Projects/Subprojects reporting at least one "predicted cost efficiency" ……..…… 4



From Section 3 of this ANNUAL REPORT, we also have:

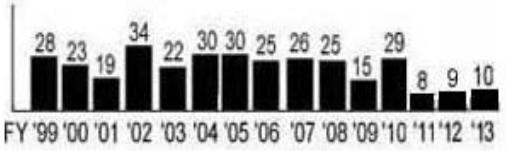
Measure 5. Journal Articles, Publications

Number of peer reviewed journal publications documenting research that appeared (12) or were accepted (10) in FY2013 …….... 22



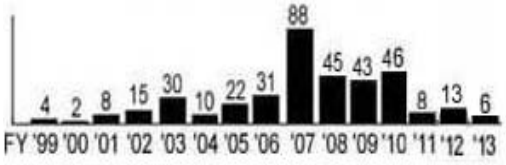
Measure 6. Proceedings, Publications

Number of proceedings publications documenting research that appeared in FY2013 ……. 10



Measure 7. Center Research Reports/Studies, Publications

Number of center research reports/studies publications documenting research that appeared in FY2013 ……..... 6



Each completed questionnaire is shared with appropriate staff to help improve our future efforts.

[1]Reorganized from Statistical Research Division to Center for Statistical Research and Methodology, beginning in FY 2011.

TABLE OF CONTENTS

1. COLLABORATION

1.1 STATISTICAL DESIGN AND ESTIMATION (Decennial Project 5610302)

1.2 AUTOMATING FIELD ACTIVITIES (INFRA & OPENS) (Decennial Project 6410301)

1.3 NON-ID PROCESSING (Decennial Project 6410307)

1.4 CODING, EDITING, AND IMPUTATION STUDY (Decennial Project 6510301)

A. Decennial Record Linkage
Description: Under this project, staff will provide advice, develop computer matching systems, and develop and perform analytic methods for adjusting statistical analyses for computer matching error with a decennial focus.

Highlights: In FY 2013, staff reviewed the current literature and updated the current list of references on microdata confidentiality. One staff member reviewed a rather long survey/overview paper for *International Statistical Review*. This project overlaps with work on project (G) "Supplementing and Supporting Non-Response with Administrative Records."

Staff: William Winkler (x34729), William Yancey, Joshua Tokle

B. Synthetic Decennial Microdata File
Description: In some cases, data users have an interest in the full microdata file whose disclosure is prohibited by law. We seek to produce synthetic individual records (microdata files) so that when we produce tables from them, the results are the same as the comparable publicly available tables from the original individual records. The synthetic individual records should be close to the underlying microdata while protecting confidentiality. The goal of this project is to produce synthetic microdata files from the decennial short form (now the American Community Survey) variables for block level geography. We are approaching the problem by using iterative proportional fitting and log linear models from fully cross-classified tables of short form variables and then creating synthetic microdata records by randomly sampling records using the estimated parameters.

Highlights: Large and sparse contingency tables naturally arise in this setting. Hence, in FY 2013, staff considered the problem of testing homogeneity in sparse two dimensional tables. Previously, staff gathered several tests that have been proposed in the literature for this problem, and staff performed an empirical study to compare the tests in terms of type I error probability and power. In FY 2013, staff refined this empirical study, completed the draft of a paper based on this work, and submitted the paper to a journal for publication. Staff revised the paper based on referee reports, and the paper was accepted for publication in the *Journal of Statistical Theory and Applications*. Work on this project has since been suspended.

Staff: Martin Klein (x37856)

C. Coverage Measurement Research
Description: Staff members conduct research on model-based small area estimation of census coverage, and they consult and collaborate on modeling census coverage measurement (CCM).

Highlights: In FY 2013, building upon research done for CCM Housing Unit estimation in FY 2012, staff reviewed the literature for small-area testing in a left-censored context, and for making modifications to cell-based estimation methods to improve their coverage properties. Staff developed a procedure for generating simulated parameter estimates, and tested programming functions for that task. A new simulation study was done. Staff tested different models in various combinations of generation and analysis, using simulated parameter estimates, and settled on an ideal parametrization for each of the generation models. Results were presented at the Joint Statistical Meetings, "Validity Testing for Coverage Properties of Small Area Models for Cell Proportions" by Gilary, Slud, and Maples and published in the conference proceedings. Staff used preliminary data analysis to compare coverage properties of the methods and assess which method was most useful.

Staff: Jerry Maples (x32873), Aaron Gilary, Ryan Janicki, Eric Slud

D. Accuracy of Coverage Measurement
Description: 2010 Census Coverage Measurement (CCM) Research conducts the research necessary to develop methodology for evaluating the coverage of the 2010 Census, including new research on feasibility of triple-system estimation methods. This includes planning, designing, and conducting the research, as well as analyzing and synthesizing the results to evaluate their accuracy and quality. The focus of this research is on the design of the Census Coverage Measurement survey and estimation of components of coverage error, with a

secondary emphasis on the estimation of net coverage error. Overcount and undercount estimation has not been done separately for previous censuses because of the difficulty of obtaining adequate data for unbiased estimates.

Highlights: In FY 2013, staff collaborated with staff in the Center for Survey Measurement (CSM) on models for recall error for reported move dates in surveys using data from survey files linked to administrative records. Censuses and census coverage measurement surveys ask respondents to recall where they lived on Census Day, April 1. Some interviews are up to eleven months later for evaluations. Respondents may be asked when they moved to their current address. The assumption has been that respondents who move around April 1 are able to give correct answers. Error in recalling a move date may cause respondents to be enumerated at the wrong location in the census. One study uses data prepared for the "Memory Recall of Migration Dates in the National Longitudinal Survey of Youth" developed under a contract with NORC. The other study uses data from the Recall Bias Study, which was part of the 2010 Census Evaluation and Experiments Program. Analyses are underway and close to completion.

Staff conducted research on methods of measuring census undercount and their importance as a way of gaining insight about subpopulations that are hard to survey. Although such groups may be a relatively small proportion of the population, they contribute disproportionately to the overall census undercount. The methods available for estimating net undercount include post-enumeration surveys, demographic analysis, administrative record matches, and reverse record checks. The study examined the strengths and weaknesses of each method and how the applicability of each method depends on whether the census is enumeration-based or register-based. The investigation was able to describe how a country's choice of a methodology for measuring census coverage error depends on the availability of the required data and the privacy and confidentiality policies surrounding the use of the data for measuring census undercount. The research produced a paper that is unique in that it provides a comprehensive discussion of all the methods currently in use for measuring census coverage in one paper.

Staff conducted research on the construction of performance measures for sub-national population estimates including those used to evaluate censuses and other estimates such as the Population Estimates Program. The research examined how these measures attempt to incorporate the concept of equity across areas or people into the evaluation of the errors in a set of sub-national population estimates. The investigation included a demonstration of the properties of the measures and an illustration of the necessity of understanding the role of error in the standard of comparison when forming the measures. Data available on the undercount in five consecutive censuses illustrated the effect of census undercount on estimates of change between censuses. Finally, the research resulted in a method to facilitate comparisons across measures when assessing a set of population estimates or studying a proposed estimation methodology.

Staff: Mary Mulry (x31759), Eric Slud, Ryan Janicki

E. Record Linkage Error-Rate Estimation Methods

Description: This project develops methods for estimating false-match and false-nonmatch rates without training data and with exceptionally small amounts of judiciously chosen training data. It also develops methods/software for adjusting statistical analyses of merged files when there is linkage error.

Highlights: In FY 2013, staff gave a series of lectures on the main ten technical papers related to error-rate estimation. All but three of the papers were written by staff; the other three papers (in the *Journal of the American Statistical Association*) were written by university researchers who had visited and worked with our center's staff. We documented the thirty programs needed for data preparation, matching, and error-rate programs. Staff went through some of the details of the programs to emphasize some of the subtle difficulties that had to be dealt with when creating the programs: so much of the academic research has failed is because of the difficult data preparation/clean-up and data structuring for the error-rate estimation to work minimally well. Staff worked in greater detail with one person in the Center for Administrative Records Research & Applications (CARRA) and one in our center who subsequently wrote papers for the Joint Statistical Meetings.

As part of this project, our center assists the Decennial Statistical Studies Division (DSSD) and CARRA with new theory, methods, and software. DSSD files were transferred to the CARRA computer in January. We received layouts for the DSSD files on March 19. Our secure terminal room became almost fully operational on March 22 but minor glitches (requiring IT assistance 1-2 times a week) continued. At our request, CARRA upgraded much of the operating system on their machine to agree with Research2. Our biggest need was for debuggers that we were able to fully test by May 23 with 2010 Census Coverage Measurement (CCM) data. We chose this data because these were supposedly very similar to – but of higher quality than – earlier 1990 Census files that we had used for error-rate estimation research. Because we can still understand the files and deal with some of their anomalies, we are now considering getting earlier versions of 2010 Census files and creating the new research files for research purposes.

Staff in CARRA wrote a SAS version of the first part of error-rate estimation software (Belin and Rubin, *JASA* 1995) which was applied to three test decks with truth that CARRA had developed. One person in our center's staff had earlier rewritten the software (4000 lines of FORTRAN code) for compatibility with our current *SRD Matching* software. With data truth decks from the 1990 Census, Winkler (2006) methods outperformed the Belin-Rubin methods, but the software is exceedingly difficult to use. The software's combinatorial routines need highly nontrivial updating for some of the characteristics of current data.

Staff provided advice and reviewed two drafts of the Joint Statistical Meetings paper on record linkage parameter estimation using Markov Chain Monte Carlo methods. Some of the advice dealt with some of the difficult anomalies of data preparation/preprocessing and creating suitable structures for parameter. Staff provided advice to two professors at Carnegie-Mellon University (CMU) who are working on projects for the Census Bureau and gave one overview lecture at CMU. Staff provided extensive advice to all groups on data preparation and use of the string comparators which typically have a bigger positive effect on improving matching efficacy than better models and computational techniques.

Staff: William E. Winkler (x34729), William E. Yancey, Joshua Tokle, Tom Mule (DSSD), Lynn Imel (DSSD), Mary Layne (CARRA)

F. Master Address File (MAF) Error Model and Quality Assessment

Description: The Master Address File (MAF) is an inventory of addresses for all known living quarters in the U.S. and Puerto Rico. This project will develop a statistical model for MAF errors for housing units (HUs), group quarters (GQs), and transitory locations (TLs). This model, as well as an independent team, will be used to conduct independent quality checks on updates to the MAF and to ensure that these quality levels meet the 2020 Census requirements.

Highlights: In FY 2013, staff determined that zero-inflated Poisson (ZIP) and zero-inflated negative binomial (ZINB) regression models provide good frameworks for modeling the number of block-level adds (undercoverage) and number of block-level deletes (overcoverage) as functions of various pre-Address Canvassing variables. We developed initial models using a reduced set of these candidate predictors based on both their statistical and practical significance in the models. We delivered a sample to the Field Directorate for the MAF Model Validation Test, which is currently planned for FY 2014. We also increased our collaboration with the Targeted Address Canvassing Research, Model, and Area Classification (TRMAC) group.

Staff: Derek Young (x36347), Pete Davis (DSSD), Nancy Johnson (DSSD), Kathleen Kephart (DSSD)

G. Supplementing and Supporting Non-Response with Administrative Records

Description: This project researches how to use administrative records in the planning, preparation, and implementation of nonresponse followup to significantly reduce decennial census cost while maintaining quality. The project is coordinated by one of the 2020 Census Integrated Project Teams.

Highlights: In FY 2013, staff continued to participate in the planning and preparation process for the research, especially the development of a Hard To Followup (HTF) index. Staff produced a draft project plan for the HTF index research and draft outlines for the HTF index. Based on the latest draft outline, a spreadsheet was created that contained potential candidate variables for the HTF index. Staff calculated Pearson and Kendall Tau B correlations among potential tract-level covariates and between potential tract-level covariates and tract-level outcome variables and ran multiple linear regressions and (where applicable) multiple logistic regressions for several tract-level outcome variables. Corresponding logistic and linear regressions produced very similar sets of predicted values. Staff produced a draft initial project report section summarizing the initial results and later produced summaries of results including tract-level covariates not included in the initial draft. Staff provided output listings from several of the linear regressions to the Decennial Statistical Studies Division (DSSD) for use in a 2013 Joint Statistical Meetings paper. Logarithm of population density was generally the most important explanatory variable and generally provided most of the explanatory power for the current set of tract-level covariates. Staff then received an ID-level file that included tract-level variables calculated from the block group level planning database and ID-level variables from the Nonresponse Followup (NRFU) contact history file. Staff looked at Pearson and Kendall Tau B correlations between various potential covariates (mostly tract-level variables) and four ID-level outcome variables (number of contacts, and indicators for conversion after the first, second, and third contacts). Staff also ran multiple linear regressions with the number of contacts as the dependent variable and multiple logistic regressions with the three conversion indicators as the dependent variable. The correlations were generally low (most absolute values were below 0.1 and most of the rest below 0.15) as were the r-square values for the regressions (all below 0.05). Logarithm of population density was again the most important explanatory variable with a household size variable also being nontrivial.

Staff: Michael Ikeda (x31756), Mary Mulry

H. Local Update of Census Addresses (LUCA) Program Improvement

Description: The purpose of this project is to assess all facets of the LUCA program to identify cost effective changes, improve the quality of the Master Address File, and optimize the benefits derived by the Census Bureau and the participants. The project is coordinated by one of the 2020 Census Integrated Project Teams.

Highlights: In FY 2013, staff participated in the research planning process.

Staff: Michael Ikeda (x31756), Ned Porter

I. Identifying "Good" Administrative Records for 2020 Census NRFU Curtailment Targeting

Description: As part of the Census 2020 Administrative Records Modeling team, staff are researching scenarios of Nonresponse Followup (NRFU) contact strategies and utilization of administrative records data. We want to identify scenarios that have reduction in NRFU workloads while still maintaining good census coverage. We are researching identification of "good" administrative records via models of the match between Census and administrative records person/address assignments for use in deciding which NRFU households to continue to contact and which to primary allocate. We are exploring various models, methods and classification rules to determine a targeting strategy that obtains good Census coverage – and good characteristic enumeration – with the use of administrative records.

Highlights: In FY 2013, staff developed a preliminary classification method based on log-linear modeling to classify administrative records according to their usefulness in the context of a decennial enumeration.

We initiated involvement with the Census 2020 Administrative Records Modeling team and reviewed the team's current research. Staff performed model diagnostics and developed classification methods for administrative records targeting and occupancy models. We developed and assessed classification methods for determining which administrative records are suitable for Census 2020 NRFU purposes. Staff participated in sharing research with the National Academy of Science advisory panel and with the Census 2020 Communications team.

Staff continues to explore and develop classification methods based on input from log-linear models for determining which administrative records are suitable for Census 2020 NRFU purposes, using model-based and rule-based approaches.

Staff: Yves Thibaudeau (x31706), Darcy Steeg Morris

J. Software Development (*Tea*)

Description: Tea is software for the editing, imputation, and disclosure avoidance of surveys. It is intended to be easily reconfigured for new surveys. By putting all of these processes in one package, we can guarantee that all imputations can pass edit requirements, and we can use advanced imputation techniques to synthesize data that would otherwise fail disclosure avoidance requirements. *Tea* is based on R and several packages for data processing, and it is documented according to professional standards.

Highlights: In FY 2013, staff implemented a packaging system allowing easy installation of *Tea* by any user. Staff also rewrote the raking algorithm (iterative proportional fitting) for use as an imputation method accommodating data with nonmonotone missingness patterns and structural zeros. We improved the use of raking for the production of fully synthetic data. We also produced a demonstration of the derivation and use of variances estimated using *Tea*'s multiple imputation framework.

Staff did a large-scale imputation test for the hypothetical scenario of zero nonresponse follow-up, imputing the individual and household characteristics of roughly 20 million people. The imputation demonstrated a noticeable reduction in bias regarding certain characteristics, notably Hispanic origin, relative to other imputation methods.

Additionally, staff fully rewrote the documentation for *Tea*, producing a manual and tutorial intended to introduce the workflow and methods to analysts new to the system. Several dozen unit tests were added to guarantee that subcomponents of the system continue to work correctly.

Finally, staff implemented the Expectation-Maximization algorithm of Hartley (1958), generalizing it for data sets with no complete observations.

Staff: Ben Klemens (x36864), Rolando Rodriguez, Yves Thibaudeau

K. Software Analysis and Evaluation

Description: This project will compare competing imputation methods for the 2020 Decennial Census. Staff will establish testing procedures for the comparison and will produce statistical and graphical output to inform any production-level decisions. The current donor-based imputation method will be tested along with numerous other methods, both from in-house software and from external sources (where feasible). Coordination with production divisions will help ensure that the procedures meet all the necessary production criteria.

Highlights: In FY 2013, staff began preliminary research on the use of log-linear models for the imputation of completely and partially missing demographic data in the 2020 Census. Staff worked to integrate these models into the *Tea* survey-processing package by developing and documenting code to execute the models and to provide a framework for data editing and analysis. Future research will involve integrating administrative data into the models to assess any benefits they may provide.

Staff: Rolando Rodriguez (x31816), Ben Klemens, Yves Thibaudeau

1.5 PRIVACY AND CONFIDENTIALITY STUDY (Decennial Project 6810304)

A. Privacy and Confidentiality for the 2020 Census
Description: This project undertakes research to understand privacy and confidentiality concerns related to methods of contact, response, and administrative records use which are under consideration for the 2020 Census. Methods of contact and response under consideration include internet alternatives such as social networking, email, and text messages. The project objectives are to determine privacy and confidentiality concerns related to these methods, and to identify a strategy to address the concerns.

Highlights: In FY 2013, staff participated in the development of the study plan for this project, and staff reviewed and provided recommendations on the experimental design for a national study of internet contact strategies.

Staff: Martin Klein (x37856)

B. Social Media Monitoring of Privacy and Confidentiality Concerns
Description: The purpose of this study is to investigate public perception on topics related to privacy and confidentiality. Using a social media listening textual mining tool, staff will access public conversation from social networking sites like Twitter to identify topics, themes, and sentiments relating to privacy and confidentiality. This study will enable staff to monitor changes over time in preparation for and implementation of advertising campaigns or other communications strategies for the 2020 census.

Highlights: In FY 2013, staff met regularly with the Social Media Subteam to assist in the development of research plans for the analysis of public discussions in social media. In these plans, staff outlined research questions and methodology in preparation for upcoming training sessions with representatives from the social media software company Sysomos.

Staff: Taniecea Arceneaux (x33440)

1.6 MATCHING PROCESS IMPROVEMENT (Decennial Project 6810305)

A. 2020 Unduplication Research
Description: The goal of this project is to conduct research to guide the development and assessment of methods for conducting nationwide matching and unduplication in the 2020 Decennial Census, future Censuses and other matching projects. Our staff will also develop and test new methodologies for unduplication. The project is coordinated by one of the 2020 Census Integrated Project Teams.

Highlights: In FY 2013, staff continued to participate in the planning and preparation process for the research. Staff provided input into an overview the Matching Process Improvement Team put together for the Acting Director. The overviews from the various Project Teams were used as part of the Acting Director's preparation for a Congressional hearing.

Staff also continued to modify the matching system used in previous research for use on the 2010 Census Unedited File (CUF) and continued to look at results of preliminary matching runs of the CUF against itself. The results so far appear largely consistent with the 2010 Duplicate Person Identification results, although the number of within-block and within-tract within response links is higher in the 2010 CUF matching. The basic patterns also appear fairly similar in many respects to the corresponding research results based on the 2000 Census, although there are fewer links with matching phone number than in 2000 and the proportion of within-block links is somewhat lower than in 2000. Several presumably invalid names (e.g. first name of “person” spelled out numbers in a name field) appear to be more common in the preliminary 2010 matching results than in they were in the 2000 research. However, the appearance of known training examples in the matching results appears to be much less of a problem in the 2010 research than it was in the 2000 research. Staff continued examining the patterns of distances between units in links from preliminary nationwide matchings of the 2010 CUF against itself. The distances are calculated from the latitude and longitude information for each unit in the link. One initial observation is that the distances do appear to separate out reasonably well by the current geographic categories (block, tract, county, state, nation) although the tails of the distance distribution for each category are worth further examination. Preliminary results also suggest that it may be useful to include the geographic distance along with the geographic category when evaluating links.

About one-sixth of the links have missing distance due to missing longitude or latitude for at least one of the units. Links with missing distance are more likely to be local links (within-block or within-tract) than links with non-missing distance.

Staff provided advice on the name and address standardization methods and software. Staff pointed out issues with the initial analysis because the empirical data set consisted solely of records on which the existing address standardizer performed well. When other (typically commercial) standardizers were compared to the existing standardizer, the existing standardizer outperformed them. Because one of the staff had been involved with the original address standardizer comparisons in 1994, staff were able to detail the needed appropriate quality of the empirical data. Based on writing the name standardizer and second-hand detailed observation of the address standardizer development, staff was able to point out some of the potential difficulties in rewriting the address standardizer after suitable empirical data is available and correctly tested. The needed characteristics of the empirical data had been discussed in detail in April-May 2012 prior to the research. The two very high quality empirical address data sets from the Decennial Statistical Studies Division (DSSD) and the Geography Division had been lost after individuals involved in the earlier (1994) development retired. Staff participated in discussions of implementing certain real-time matching methods with the main team and several other sub-teams of the other 2020 Census research teams. Staff and DSSD programmers confirmed that the methods were straightforward to implement in the new applications. The original matching code, at the request of DSSD, had been written in a modular manner allowing straightforward extraction and insertion of modules in new matching applications.

Staff: Michael Ikeda (x31756), Ned Porter, Bill Winkler, Bill Yancey, Joshua Tokle

1.7 AMERICAN COMMUNITY SURVEY (ACS) (Decennial Project 5385260)

A. ACS Applications for Time Series Methods
Description: This project undertakes research and studies on applying time series methodology in support of the American Community Survey (ACS).

Highlights: In FY 2013, staff completed revisions to a paper describing how to interpret multi-year estimates, after receiving comments from referees. Staff also formulated a spatial model for survey data, designed to produce estimates of increased precision by smoothing over neighboring values.

Staff: Tucker McElroy (x33227)

B. ACS Imputation Research and Development
Description: The American Community Survey process of editing and post-edit data-review is currently time and labor intensive. It involves repeatedly submitting an entire collection year of micro-data to an edit-enforcement program (SAS software). After each pass through the edit-enforcement program, a labor-intensive review process is conducted by a staff of analysts to identify inconsistencies and quality problems remaining in the micro-data. Before the data are ready for public release, they have least three passes through the edit-enforcement program and three review processes by the analysts, taking upward of three months. The objective of this project is to experiment with a different strategy for editing, while keeping the same edit rules, and to assess if the new strategy can reduce the number of passes through the edit process and the duration of the review process.

Highlights: In FY 2013, we developed and presented a plan to research and expand the current sequential hot-deck methods, not mode-based, to mode-based "real-time" imputation, in the sense that the imputation could proceed based on a smaller set of available imputation donors.

First, staff submitted a proposal for a feasibility study of "real-time" edit and imputation. The edit (and imputation) system would be operational throughout the entire cycle of the ACS and would allow for continuous quality control and quality management operations. The objective is to allow more time for identifying persistent edit failures and distorting edits, and fix these failures and edits earlier in the cycle of the survey. Real-time imputation would also support adaptive design and allow for more informed field decisions. This would contrast with the current system, which relies on a larger staff of analysts tasked with reviewing the edited data within a two month period, after all the data are collected. This staff is under considerable stress and the pressure to meet deadlines imposed by the production schedule is significant. The short delays make it difficult to identify distortions, residual edit failures, and guarantee the data are clean.

Second, staff presented a proposed methodology based on the decision-theoretical concepts to assess the best data collection action. This methodology involves "real-time imputation" to assess the risk of an imputation versus more data collection efforts. Staff presented the infrastructure for informative real-time imputation at the Joint Statistical Meetings.

Staff: Yves Thibaudeau *(*x31706), Chandra Erdman, Darcy Steeg Morris

C. Data Analysis of ACS CATI-CAPI Contact History

Description: The aim of this project is to reanalyze data on Computer Assisted Telephone Interview (CATI) and Computer Assisted Personal Interview (CAPI) contact histories so as to inform policy decisions on altering the control parameters governing termination of CATI contact attempts with a view to minimizing perceived harassment by the American Community Survey (ACS) sampled households without incurring large costs in lost CATI interviews or increased CAPI workload.

Highlights: In FY 2013, a data analysis team from our center produced exploratory data analyses and displays of the time course of interview completion for ACS CATI subgroups defined in terms of call history variables collected for ACS-sampled households such as numbers of Refusals or Hangups or requests for Callback. Staff developed these into more complete data analyses featuring: (i) overplots of graphs summarizing cumulative interview counts, by call number, of CATI subgroups defined through the call-history variables (Refusals, Hangups, Callback requests); (ii) novel summaries of interview yield per call for these subgroups through plots of discrete hazard functions; and (iii) tables of costs and a novel measure of perceived harassment for 14 different hypothetical CATI termination policies contrasted with the current policy. This research influenced ACS staff in recommending policy changes (Griffin and Hughes 2013) concerning the control parameters governing repeated attempts to contact sampled households within ACS-CATI.

Jointly with Decennial Statistical Studies Division (DSSD) and American Community Survey Office (ACSO) staff working on this project, we presented our results in May 2013 in a Brown Bag seminar talk on the first phase of the data analysis of CATI response in terms of contact history and reluctance. In a follow-on project conducted under ACS auspices, staff used similar techniques to study personal-interviewer (CAPI) responses to ACS in terms of subgroups defined dynamically by contact history. Results of the CATI and CAPI data analyses were prepared for presentation in the 2013 Federal Committee on Statistical Methodology (FCSM).

Staff: Eric Slud (x34991), Darcy Morris, Josh Tokle, Jerzy Wieczorek, Tom Petkunas, Debbie Griffin (ACSO), Chandra Erdman

D. Assessing Uncertainty in ACS Ranking Tables

Description: This project presents results from applying statistical methods which provide statements of how good the rankings are in the ACS Ranking Tables (see The Ranking Project: Methodology Development and Evaluation Research Section under Projects 0351000 and 1871000).

Highlights: In FY 2013, using 2011 ACS published state estimates for the mean travel time to work (minutes) for workers 16 years and over who did not work at home, we illustrated the methods highlighted under *The Ranking Project: Methodology Development and Evaluation* listed under Projects 0351000/1871000 – General Research.

Using ACS 2011 PUMS data, staff also illustrated the discussion of the bootstrap with a limited empirical investigation of three bootstrap variations, two of which are nonparametric and one of which is parametric. We obtained empirical results providing evidence against the use of unweighted PUMS data and an argument for the use of the parametric bootstrap approach along with its advantages of less computation, less code to debug, and no need to store the microdata. Results of the empirical investigation are presented in a draft manuscript, "An Overview of Some Concepts for Potential Use in Ranking Populations Based on Sample Survey Data."

Staff also focused on visualizations of results in ACS Ranking Tables, but results are still being developed with a *SUMMER AT CENSUS* scholar.

Staff: Tommy Wright (x31702), Martin Klein, Jerzy Wieczorek, Derrick Simmons, Nathan Yau (Flowingdata.com)

1.8 DEMOGRAPHIC STATISTICAL METHODS DIVISION SPECIAL PROJECTS (Demographic Project TBA)

A. Tobacco Use Supplement (NCI) Small Domain Models

Description: In the first quarter of FY 2013, staff worked with Demographic Statistical Methods Division (DSMD) on a project for the National Cancer Institute (NCI), studying the relationship between smoking status and a range of geographic/demographic covariates. Using the Tobacco Use Supplement to the Current Population Survey (TUS-CPS), staff is assisting NCI toward making estimates of smoking related behavior using county-level or state-level dependent variables (e.g., percent of males, percent Hispanic, percent below poverty level). The goal is to identify where anti-smoking funds could best be directed.

Highlights: In FY 2013, staff worked with the NCI to finalize models for smoking-related rate variables (e.g., former smoking, people banned from smoking at work, etc.) for U.S. counties for 2006-2007 data. Staff used model-based estimates from 2006-2007 data as input to a Fay-Herriot small-area model for estimating those variables, to be implemented using Gibbs Sampling software, with features of the sampling scheme incorporated into the model. Staff worked with the NCI to develop and refine a variable to measure the rate of

quitting smoking (one of the six), and to hone regression models for estimating the six variables. Staff met with NCI to discuss progress and modeling strategies for the six smoking covariates. Based on these exchanges, staff changed the modeling to incorporate multiple design effects, and modeled one of the variables (previously arcsine transformed) on the probability scale.

Staff provided data to NCI for benchmarking estimates to the state level and for further testing of models with arcsine transformation removed. Staff also imported more recent TUS-CPS data and began using it for testing. Currently, staff is producing diagnostics to evaluate and explore modifications to the modeling, to produce and release estimates for each variable among all U.S. counties for 2011 data.

Staff: Aaron Gilary (x39660), Partha Lahiri (University of Maryland), Benmei Liu (NCI)

B. Special Project on Weighting and Estimation
Description: This project involves regular consulting with Current Population Survey (CPS) Branch staff on design, weighting, and estimation issues regarding the CPS. Issues discussed include design strategy for systematic sampling intervals, for rotating panels, composite estimation, variance estimation, and also the possibility of altering CPS weighting procedures to allow for a single simultaneous stage of weight-adjustment for nonresponse and population controls.

Highlights: Throughout FY 2013, staff met regularly to discuss research on tracking CPS weights through successive weight-adjustment stages according to current methodology, and met with Bureau of Labor Statistics (BLS) staff to discuss the specification of hard constraints (population-control) and soft constraints prescribing that adjusted-weighted totals of certain survey attributes must approximately equal the corresponding base-weighted totals. Discussions in this project have formulated weight adjustment through a single optimization-step minimizing a loss function measuring the change from base to adjusted weights, penalized by the sum of quadratic penalties measuring the discrepancies of adjusted minus base weight soft-constraint totals, subject to the hard constraints.

Through additional discussions, we refined the definition of hard and soft constraints in the stages of CPS weighting up to and including the Second Stage adjustment, resulted in tabular and graphical displays of weight adjustments in CPS. These weight-change summaries resulted in a strategy for defining the penalty-term coefficients for quadratic penalties corresponding to soft-constraint adjustment discrepancies in the objective-function for the single-stage optimization approach. A preliminary algorithm for optimization resulted in novel single-stage calculations of CPS calibrated weight adjustments. This research was written and presented as a paper at the 2013 Joint Statistical Meetings, to appear in the *2013 Proceedings of the American Statistical Association* (ASA).

The optimization problem defined in this research is seen to be a very large quadratic programming problem of very special structure. Staff have coded a special-purpose quadratic programming algorithm which is still being tested for the exact solution of this problem.

Staff: Eric Slud (x34991), Reid Rottach (DSMD), Christopher Grieves (DSMD), Yang Cheng (DSMD)

1.9 DEMOGRAPHIC SURVEYS DIVISION (DSD) SPECIAL PROJECTS
(Demographic Project 0906/1442)

A. Data Integration
Description: The purpose of this research is to identify microdata records at risk of disclosure due to publicly available databases. Microdata from all Census Bureau sample surveys and censuses will be examined. Potentially linkable data files will be identified. Disclosure avoidance procedures will be developed and applied to protect any records at risk of disclosure.

Highlights: In FY 2013, staff identified new strategies to look for possible risks of disclosures. One possible idea involved web scraping for potential data. We looked at commercial people locater sites such as veromi.net and real estate sites like zillow.com which could be used to collect information on dwellings to attack the American Community Survey (ACS) Public Use Microdata Sample (PUMS) data in new ways. Staff also recommends collaboration, input and support from the Center for Administrative Records Research (CARRA) to pursue other potential vulnerabilities.

Staff: Ned Porter (x31798), Lisa Singh (CDAR), Rolando Rodríguez

1.10 NATIONAL CRIME VICTIMIZATION SURVEY
(Demographic Project 7523013/7523014)

A. Analyzing the Effects of Sample Reinstatement, Refresher Training Experiment, and Process Monitoring and Fitness for Use

Analyzing the Effects of Sample Reinstatement
Description: During 2010 and 2011, the National Crime Victimization Survey (NCVS) sample size was restored (increased) to previous levels. This, in conjunction with the realignment imposed by the closing of six Regional

Offices, brought changes to interviewer workloads, with possible impact on victimization measures for households and persons. Through analysis of survey outcomes and paradata, we seek to quantify the effects of reinstatement and realignment on victimization rates.

Highlights: In FY 2013, staff devised and implemented a new class of Bayesian multilevel models for analyzing longitudinal summaries of paradata and survey outcomes. These models describe long-term trends, annual periodic (seasonal) effects, and effects of management interventions (reinstatement and realignment). We implemented these models in R and Fortran, applied these models to pooled data from NCVS 2008-2012, and provided results to the Bureau of Justice Statistics in preparation for the 2013 Data Review Panel. Staff applied the models to two key paradata variables (household response rate, avg. screener time) and to two key survey outcomes (rate of household property crimes, rate of personal crimes). Models were refined and revised in response to input from Bureau of Justice Statistics. We summarized our findings in a presentation and a written report that was distributed to members of the NCVS Data Review Panel.

Analysis of Refresher Training Experiment

Description: In 2011, an experiment was embedded within the NCVS. Teams of interviewers were randomly assigned to two cohorts. The first cohort received specialized training that was designed to improve the quality of the interview process, and the second cohort received the same training six months later. Through modeling of survey outcomes and paradata, we seek to quantify the effects of the so-called Refresher Training program on victimization rates.

Highlights: In FY 2013, staff finished analyses of the 2011 Refresher Training Experiment. We demonstrated that Refresher Training increased the reporting in NCVS of personal and household property crimes that were never reported to police, but had no discernible impact on crimes not reported to police. The results were summarized in a technical report and submitted for journal publication.

Process Monitoring and Fitness for Use

Description: Information gathered from NCVS field operations is synthesized into variables that serve as indicators of data quality. In this project, we are developing classes of flexible models and graphical tools for describing how these variables evolve over time. These techniques are intended to help the Census Bureau and the Bureau of Justice Statistics staff to monitor the performance of field staff, to describe the effects of interventions on the data collection process, to quickly alert survey management to unexpected developments that may require remedial action, and to assess the overall quality of NCVS data and their fitness for use.

Highlights: In FY 2013, a book chapter on Bayesian spline models for process monitoring was finalized and published.

Staff: Joe Schafer (x31823), Isaac Dompreh

1.11 POPULATION DIVISION PROJECTS (Demographic Project TBA)

A. Population Projections

Description: This project provides methodology and software to generate long-term forecasts for fertility, mortality, and migration data using vector time series techniques.

Highlights: In FY 2013, staff documented methods and code for projecting fertility and mortality data by age and race group over a 50-year time horizon. A research report was written and revised, based on comments from Bill Bell. The report was revised to discuss bootstrap methods.

Staff: Tucker McElroy (x33227), Osbert Pang, William Bell (R&M)

1.12 SURVEY OF INCOME AND PROGRAM PARTICIPATION IMPROVEMENTS RESEARCH (Demographic Project 1465444)

A. Model-Based Imputation for the Demographic Directorate

Description: Staff has been asked to review and improve ultimately all of the imputation methodology in demographic surveys, beginning with the Survey of Income and Program Participation and the Current Population Survey.

Highlights: In FY2013, we wrote a draft report which includes a summary of model-based imputation methods for imputing monthly earnings at the job level in the Survey of Income and Program Participation (SIPP). In the report, we described a Sequential Regression Multiple Imputation (SRMI) model for imputing SIPP earnings as an alternative to hot-deck imputation using SRMI as implemented in the general Multiple Imputation software of Su et al. (2001). The report highlights that the main advantage of using this available R package for SRMI makes it possible to easily modify the model and apply it to other SIPP variables with minimal effort from the user. We provide comparison results of the SRMI and the randomized hot-deck as implemented in CSRM generalized system TEA using multiple simulated SIPP data files with missing at random monthly earnings. We reported that the SRMI model significantly outperforms

the hot-deck procedure in RMSE. Also, the model-based method produces estimates of average monthly earnings that have significantly smaller variances when compared to average monthly earnings estimates from data imputed using the randomized hot-deck method.

Staff: Maria Garcia (x31703), Chandra Erdman, Ben Klemens, Yves Thibaudeau

1.13 SOCIAL, ECONOMIC, AND HOUSING STATISTICS DIVISION SMALL AREA ESTIMATION PROJECTS (Demographic Project 7165013)

A. Research for Small Area Income and Poverty Estimates (SAIPE)

Description: The purpose of this research is to develop, in collaboration with the Small Area Estimates Branch in the Social, Economic, and Housing Statistics Division (SEHSD), methods to produce "reliable" income and poverty estimates for small geographic areas and/or small demographic domains (e.g., poor children age 5-17 for counties). The methods should also produce realistic measures of the accuracy of the estimates (standard errors). The investigation will include assessment of the value of various auxiliary data (from administrative records or surveys) in producing the desired estimates. Also included would be an evaluation of the techniques developed, along with documentation of the methodology.

Highlights: In FY 2013, staff conducted an expanded simulation study to estimate the error in the first order approximation for the precision of variance estimates of rates from the American Community Survey (ACS). With these results, staff can calibrate the approximation to more accurately reflect the precision for areas with small sample sizes. Staff also tested using multiple years of the ACS to examine whether we can obtain better (i.e., lower variances) for county level poverty rate estimates. This bivariate model uses the previous 5-year combined ACS dataset for the second equation. This 5-year model would take the place of the decennial long form data.

Staff explored the use of a new bivariate generalized linear mixed model (GLMM) for use in SAIPE county estimates. Staff studied both hierarchical Bayes and empirical Bayes implementations of the model, using JAGS and R, SAS *NLMIXED PROC* as well as R's *glmer4*. Prediction results were virtually identical across the two methods. We improved the performance of our original GLMM by the use of a Generalized Variance Function (GVF), and implemented an iterative approach to inference. We compared both predictions and prediction interval widths with those of the unranked production estimates. The predictions were broadly similar, while the prediction intervals appeared to be a bit wider in the proposed model, except in the cases where the prediction intervals are widest for the production model prediction intervals. The proposed model has the further advantage that it makes it unnecessary to drop counties that have a zero count from the model fitting, unlike in the current model. It also obviates the need to use estimates from Census 2000 long form data, which is increasingly out of date, and accounts for the sampling error from using a second surveys' estimator in the model, which is not accounted for in the current SAIPE model. This work is documented in the paper "Applying Bivariate/Logit Normal Models to Small Area Estimation" by Carolina Franco and William R. Bell.

Staff: Jerry Maples (x32873), Carolina Franco, William Bell (R&M)

B. Small Area Health Insurance Estimates (SAHIE)

Description: At the request of staff from the Social, Economic, and Housing Statistics Division (SEHSD), our staff will review current methodology for making small area estimates for health insurance coverage by state and poverty level. Staff will work on selected topics of SAHIE estimation methodology, in conjunction with SEHSD.

Bayesian Benchmarking of Estimates from Distinct Geographic Models

Highlights: In FY 2013, staff continued work on benchmarking methods for reconciling models and point estimates from distinct geographic areas. We developed methods which benchmark second moments as well as first moments by modifying posterior distributions through Kullback-Leibler minimization. Staff developed simulation methods for understanding the effect of a second moment constraint on estimation procedures and confidence intervals and how these new estimates compare to estimates made using current SAHIE benchmarking methodology. Staff also used these simulation studies to numerically verify theoretical results and to understand how different the benchmarked posterior distributions differ from the original posterior distributions. We wrote a paper documenting this work.

Staff: Ryan Janicki (x35725)

1.14 IMPROVING POVERTY MEASURES/IOE (Demographic Project 0189115)

A. Tract Level Estimates of Poverty from Multi-year ACS Data

Description: This project is from the Development Case Proposal to improve the estimates of poverty related outcomes from the American Community Survey (ACS) at the tract level. Various modeling techniques, including model-based and model-assisted, will be used to improve

on the design-based multi-year estimates currently produced by the ACS. The goal is to produce more accurate estimates of poverty and income at the tract level and develop a model framework that can be extended to outcomes beyond poverty and income.

Highlights: In FY 2013, staff created a software system to turn the unweighted 5-year ACS sample into an artificial population. The purpose of this artificial population is to help validate candidate models for tract-level poverty estimates, through simulation of ACS-like samples, which can be evaluated against a known truth. This software system includes: creation of artificial population, ability to draw multiple ACS-like samples, and creation of design-based estimates of poverty and their sampling variances. Staff improved the artificial population system's ACS-like sampling process by including additional raking and weighting adjustments, storing housing-unit-level samples, and computing additional summary statistics on each sample. Staff also began investigating a more sophisticated nonresponse model to replace the initial simple version. Finally, staff ported the system to the "sae" server for use by Small Area Estimates Branch staff, who began work on developing "pseudotracts" – groups of Census tracts whose ACS samples can be pooled to create tract-sized groups in the artificial population. This artificial population and the system for drawing samples will be used in the planned FY 2014 evaluation study for track level poverty estimates.

Staff: Jerry Maples (x32873), Jerzy Wieczorek, Ryan Janicki, Aaron Gilary, William Bell (R&M), Carolina Franco

B. Small Area Estimates of Disability

Description: This project is from the Development Case proposal to create subnational estimates of specific disability characteristics (e.g., number of people with autism). This detailed data is collected in a supplement of the Survey of Income and Program Participation (SIPP). However, the SIPP is only designed for national level estimates. This project is to explore small area models to combine SIPP with the large sample size of the American Community Survey to produce state and county level estimates of reasonable quality.

Highlights: In FY 2013, the team for the Disability Estimates project was formed and access to the SIPP survey data and SSI disability administrative records data was obtained. Staff pursed two modeling approaches: unit-level regression projection (based on Kim and Rao 2012) and area-level bivariate Fay-Herriot. Staff identified predictors of disability that were in common between the SIPP and ACS survey (key variables were age, SSI disability information from administrative records and general ACS-style questions on disability). Staff implemented the two methods and made predictions for state-level disability rates, i.e. people that have any disability. The regression projection method did not achieve the expected variance reduction and staff is modifying the methods to include random effects. Staff also obtained feedback at the Joint Statistical Meetings and will be investigating predictive mean matching method. Staff presented the results on the regression projection modeling at the 2013 Joint Statistical Meetings and documented them in the proceedings paper "Improving Small Area Estimates of Disability: Combining the American Community Survey with the Survey of Income and Program Participation" by Jerry Maples and Matthew Brault.

Staff: Jerry Maples (x32873), Jiashen You, Matthew Brault (SEHSD)

1.15 EDITING METHODS DEVELOPMENT (Economic Project 2320354)

A. Investigation of Selective Editing Procedures for Foreign Trade Programs

Description: The purpose of this project is to develop selective editing strategies for the U.S. Census Bureau foreign trade statistics program. The Foreign Trade Division (FTD) processes more than five million transaction records every month using a parameter file called the Edit Master. In this project, we investigate the feasibility of using selective editing for identifying the most erroneous records without the use of parameters.

Highlights: In FY 2013, we researched selective editing methodologies for our foreign trade data with the objective of evaluating an application of selective editing earlier in the editing processing. We had previously developed score functions for selective editing of trade data rejects based on how suspicious a record is and the potential effect suspicious records have on the final totals. We found that the measure of potential effect does not work well when applied to trade data records prior to automatic editing. In this case, the denominator in the measure of potential effect becomes very large and the potential effect becomes negligible; it does not add any meaningful information for computing scores. We used a measure of the potential error rather than the effect errors have on final totals, and we proposed a global score function incorporating suspicion and potential error for assigning each record a score.

We designed an evaluation study using four consecutive months of reported and edited exports data along with the FTD's editing and imputation parameter file. We simulated an application of selective editing to this larger test data file (more than 3.25 million records). We used a simulation approach to determine the effect of different levels of review on the bias in the target parameters. We calculated the absolute pseudo-bias to estimate the bias

due to errors remaining in the target parameters after processing *p*% of the records through selective editing. We simulated that only the top ranked *p*% of records are flagged for analysts' review by replacing raw values at the top *p*% of the records with available edited values while keeping raw values for records with a score lower than the chosen *p*% review level cut-off value. We calculated review levels cut-off values at different levels of aggregations showing that we could stop reviewing records when the effect of editing more records on the pseudo-bias approaches zero and the estimated parameters approach the final publication estimates. We also found that a high proportion of records ranked as highly suspicious are true rejects. This is an indication that selective editing is performing well in terms of correctly tracking erroneous records.

Staff: Maria Garcia (x31703), Yves Thibaudeau, Andreana Able (FTD)

1.16 TIME SERIES RESEARCH (Economic Project 2320352)

A. Seasonal Adjustment Support

Description: This is an amalgamation of projects whose composition varies from year to year but always includes maintenance of the seasonal adjustment and benchmarking software used by the Economic Directorate.

Highlights: In FY 2013, staff provided seasonal adjustment and *X-13ARIMA-SEATS* support to the following: Barclays Research, Business Cycle Institute, Capgemini (UK), The Conference Board, Esurance, Gavea Fund, Global Marketing Analytics, Haver Analytics, Hispanic America, IHS Global Insight (Poland), Pharo Fund, PayPal, Bureau of Economic Analysis, Bureau of Labor Statistics, City of Virginia Beach, Connecticut Office of Fiscal Analysis, Department of Housing and Urban Development, Department of Transportation, Tennessee Department of Finance, Jacksonville Sheriff's Office, Australian Bureau of Statistics, DANE (Columbia), Economic and Social Research Institute (Japan), Federal Office of Statistics (Switzerland), INEGI (Mexico), Instituto Nacional de Estadística (Spain), National Academy of Social Science (China), Office of National Statistics (UK), Statistical Office of the Federal Employment Agency (Germany), Statistics Canada, Statistics Netherlands, Statistics New Zealand, Statistics Norway, Statistics South Africa, Bank of England, Bank of Spain, Bundesbank (Germany), Central American Monetary Council, Central Bank of Sweden, Croatian National Bank, Deutsche Bank, International Monetary Fund, National Bank of Denmark, Reserve Bank of India, Harvard Business School, Ohio University, James Cook University (Australia), Moscow Institute of Physics and Technology (Russia), and Pontifical Catholic University (Brazil).

Staff from our center's Time Series Research Group and the Office of Statistical Methods and Research for Economic Programs (OSMREP) Time Series Methods Staff developed a response to questions from a columnist and blogger from the *Wall Street Journal*. Staff from our center's Time Series Research Group and OSMREP Time Series Methods Staff met with analysts from the Department of Transportation to discuss modeling and seasonal adjustment of transportation series.

Staff gave a presentation at the *X-13ARIMA-SEATS* user group meeting on December 20, 2012 on new features in the upcoming release of the *X-13ARIMA-SEATS* software.

Staff from our center's Time Series Research Group and OSMREP Time Series Methods Staff met with economists from the Longitudinal Employer-Household Dynamics (LEHD) staff to discuss the seasonal adjustment of quarterly LEHD series. Staff from the Time Series Research Group met again later with the LEHD staff to discuss recent research in multivariate seasonal adjustment, as well as other issues related to seasonal adjustment of multiple series.

Staff from our center's Time Series Research Group and OSMREP Time Series Methods Staff met with staff from Statistics New Zealand to discuss time series and seasonal adjustment issues.

Staff: Brian Monsell (x31721), Tucker McElroy, Christopher Blakely, Osbert Pang, David Findley (Consultant), William R. Bell (Research and Methodology Directorate)

B. Seasonal Adjustment Software Development and Evaluation

Description: The goal of this project is a multi-platform computer program for seasonal adjustment, trend estimation, and calendar effect estimation that goes beyond the adjustment capabilities of the Census *X-11* and Statistics Canada *X-11-ARIMA* programs, and provides more effective diagnostics. This fiscal year's goals include: (1) continue developing a version of the *X-13ARIMA-SEATS* program with accessible output and updated source code so that, when appropriate, SEATS adjustments can be produced by the Economic Directorate; (2) developing software system that provides a simulation environment for *X-13ARIMA-SEATS* seasonal adjustments called *iMetrica*; and (3) incorporating further improvements to the *X-13ARIMA-SEATS* user interface, output and documentation. In coordination and collaboration with the Time Series Methods Staff of the Office of Statistical Methods and Research for Economic Programs (OSMREP), the staff

will provide internal and/or external training in the use of *X-13ARIMA-SEATS* and the associated programs, such as *X-13-Graph*, when appropriate.

Highlights: In FY 2013, staff released an updated version of *X-13ARIMA-SEATS* (Version 1.1, Build 1), to the Economic Directorate for testing. Staff added an option to allow the user to set a critical value for AIC testing. Staff compared adjustments from this version of the software to the last released version of *X-13ARIMA-SEATS* (Version 1.0, Build 149) and found in almost all cases no differences in the adjustments. Staff worked with SSSD analysts to explain differences in their adjustments from Version 1.0 to Version 1.1 – compiling the software without optimization eliminated those differences. Staff also corrected a defect in the AIC testing procedure for user-defined regressors in the current and updated versions of *X-13ARIMA-SEATS*, corrected estimation of irregular regression models, and corrected formatting errors in the accessible HTML output. Staff updated the *SEATS* routines in *X-13ARIMA-SEATS* so that the *SEATS* routines match those of more recent version of *SEATS+*. Staff also added a diagnostic from *TRAMO+* to the *X-13ARIMA-SEATS* program to detect seasonality in a number of time series, revised the accessible HTML output, added a new option that allows XHTML output to be produced. Once these developments were finished and tested, Version 1.1 Build 8 of *X-13ARIMA-SEATS* was released to the public.

Staff updated *iMetrica* in the following ways: a) we developed a new model comparison interface for the *uSimX13* module of *iMetrica* which compares the aggregate sum of up to M step ahead forecasts for many different *SARIMA* model combinations and regressor components; b) we added some more specific regressor component options for different types of outliers; c) we added access to *X11* trend/seasonal adjustment filters in *uSimX13* (before, only the *SEATS* trend and seasonal adjustment filters were accessible) and updated *X-13ARIMA-SEATS* code within the module; d) we developed Forecastable Component Analysis (ForeCA) into *iMetrica* as multivariate time series dimension reduction tool; e) we built a spectral density design toolkit for the multivariate direct filtering approach (MDFA) module which covers smoothing, multitapering methods, Gaussianizing, and general autoregressive–moving-average (ARMA) models; f) we developed an adaptive signal extraction methodology for the multivariate direct filter module of *iMetrica*; and g) we added a data interface with Federal Reserve Economic Data (FRED).

The idea of (f) was to improve future out-of-sample signal extraction results after a specific amount of new observations have been added to the time series. A seminar in our center was given on the topic of this new development.

Staff compiled an updated version of the *TRAMO* time series modeling software and developed a simulation interface to enable a study of *TRAMO*'s model identification procedure.

Staff: Brian Monsell (x31721), Christopher Blakely

C. Research on Seasonal Time Series - Modeling and Adjustment Issues

Description: The main goal of this research is to discover new ways in which time series models can be used to improve seasonal and calendar effect adjustments. An important secondary goal is the development or improvement of modeling and adjustment diagnostics. This fiscal year's projects include: (1) continuing research on goodness of fit diagnostics (including signal extraction diagnostics and Ljung-Box statistics) to better assess time series models used in seasonal adjustment; (2) studying the effects of model based seasonal adjustment filters; (3) studying multiple testing problems arising from applying several statistics at once; (4) determining if information from the direct seasonally adjusted series of a composite seasonal adjustment can be used to modify the components of an indirect seasonal adjustment, and more generally investigating the topics of benchmarking and reconciliation for multiple time series; (5) studying alternative models of seasonality, such as Bayesian and/or long memory models and/or heteroskedastic models, to determine if improvement to seasonal adjustment methodology can be obtained; (6) studying the modeling of stock holiday and trading day on Census Bureau time series; (7) studying methods of seasonal adjustment when the data is no longer univariate or discrete (e.g., multiple frequencies or multiple series); (8) studying alternative seasonal adjustment methods that may reduce revisions or have alternative properties; and (9) studying nonparametric methods for estimating regression effects, and their behavior under long range dependence and/or extreme values.

Highlights: In FY 2013, (a) staff developed methodology for testing non-nested model comparisons via the generalized likelihood ratio test statistic. Illustrations were developed and implemented with R software, and size and power studies conducted; (b) staff continued research on quantifying statistical error in the visual significance graphical tool, and implemented the methodology in R. We met with external researchers to identify additional projects related to the visual significance graphical tool, and derived a general result on asymptotic properties of discrete Fourier transforms at non-Fourier frequencies; (c) staff refined R code to estimate dynamic factor unobserved component multivariate time series models, allowing for common trends and other general collinearities – by jointly modeling seasonality, it may be feasible to undertake multivariate seasonal adjustment. We applied the

methodology to housing and retail series, and quantified the increased precision in the multivariate approach; (d) staff derived recursive algorithms to efficiently compute block-Toeplitz precision matrices, and developed a number of applications, including likelihood evaluation, simulation, and signal extraction.

Staff: Tucker McElroy (x33227), Christopher Blakely, James Livsey, Brian Monsell, Osbert Pang, William Bell (Research and Methodology Directorate), David Findley (Consultant)

D. Identifying Edits in the Quarterly Financial Report
Description: The Quarterly Financial Report gets frequently revised due to reporting error. This project utilizes statistical analysis of the revision time series across vintages to identify potential edit mistakes.

Highlights: In FY 2013, staff met with the Economic Directorate. Staff developed a statistical method utilizing kernel density estimates of the revision difference distribution, encoded this in R, and tested their proposed method. The results were presented to our clients.

Staff: Tucker McElroy (x33227), Osbert Pang

E. Supporting Documentation and Software for X-13ARIMA-SEATS

Description: The purpose of this project is to develop supplementary documentation and utilities for *X-13ARIMA-SEATS* that enable both inexperienced seasonal adjustors and experts to use the program as effectively as their backgrounds permit. This fiscal year's goals include improving the *X-13ARIMA-SEATS* documentation, further developing the iMetrica software and documentation, and exploring the use of component and Java software developed at the National Bank of Belgium.

Highlights: In FY 2013, staff updated and released the *X-13ARIMA-SEATS Reference Manual* to include information on new options and diagnostics. The sections of the documentation dealing with the spectrum diagnostic were updated as well. Staff also updated the current quick reference for the *X-13ARIMA-SEATS* program. In addition, two "getting started" guides to the *X-13ARIMA-SEATS* and *Win X-13* programs were revised extensively and released to the public - Getting Started with *X-13ARIMA-SEATS* Input Files (Accessible Version) and Getting Started with *X-13ARIMA-SEATS* Input Files.

Staff released documentation for the two modules of the *iMetrica* software - *iMetrica-SSM*: A State Space Modeling Graphical User-Interfaced Environment Featuring *regComponent* and *iMetrica-uSimX13*: A Graphical User-Interfaced Time Series Modeling and Simulation Environment Featuring *X-13ARIMA-SEATS*.

Maintenance of the *X-12-ARIMA* and *X-13ARIMA-SEATS* websites continued to ensure that they follow standards established by the Census Bureau.

Staff from our Time Series Research Group and the Office of Statistical Methods and Research for Economic Programs (OSMREP) Time Series Methods Staff gave an extensive, detailed, written response to a Eurostat request for comments on a draft user manual chapter for Eurostat's Demetra+ seasonal adjustment program regarding *X-12-ARIMA* capabilities in Demetra+. The most important issues were modifications to *X-12-ARIMA* methods and replacement diagnostics that Census Bureau experts disagree with which were not identified as deviations from *X-12-ARIMA*.

Staff: Brian Monsell (x31721), Christopher Blakely, David Findley (consultant), William Bell (Research and Methodology Directorate)

1.17 GOVERNMENTS DIVISION PROJECT ON DECISION-BASED ESTIMATION (Economic Project TBA)

Description: This project involves providing consultative work for Governments Division (GOVS) on point and variance estimation for total government employment and payrolls in the Survey of Public Employment and Payroll, within a framework of stratumwise GREG estimation, after possibly collapsing substrata of small versus large units according to the results of hypothesis tests on equality of regression slopes. Further design issues and small area estimation of totals within government-function subtypes are also discussed.

Highlights: During FY 2013, staff performed additional simulations for a revision of the journal paper previously submitted in FY 2012 on the theory and bootstrap variance estimation for a decision-based method of stratified regression estimation applicable in the Annual Survey of Public Employment and Payroll (ASPEP) by the Governments Division. Staff completed and submitted the revision of this paper, which was accepted and will appear in *Survey Methodology*.

In addition, staff continued occasional discussions with GOVS staff on regression-based model-assisted estimation in ASPEP and on small-area estimation relating to domain estimates restricted to state-by-government-function subtypes.

Staff: Eric Slud (x34991), Gauri Datta, Bac Tran (GOVS)

1.18 USE OF BIG DATA FOR RETAIL SALES ESTIMATES (Economic Project TBA)

Description: In this project, we are investigating the use of "Big Data" to fill gaps in retail sales estimates currently produced by the Census Bureau. First Data, a global payment processing company, collects data on all electronic payment transactions (e.g. credit card and debit card transactions) from their merchant locations as a byproduct of the services they offer. We are interested in exploring possibilities of 1) using First Data tabulations to improve/enhance Census Bureau estimates of monthly retail sales - for example, validation and calibration, and 2) combining First Data tabulations with other Census Bureau data to potentially produce a new product - for example, producing estimates at smaller geographies.

Highlights: In FY 2013, staff attended meetings with a team in the Economic Directorate and First Data to discuss potential uses of First Data's tabulations of electronic payment transactions. Meetings were planned (1) with our center staff and Economic Directorate staff to discuss Census Bureau retail sales surveys and (2) to visit First Data headquarters.

Staff: Darcy Steeg Morris (x33989), Osbert Pang, Tommy Wright, Bill Bostic (ADEP), Scott Scheleur (SSSD), Bill Davie, Jr. (SSSD)

1.19 STATISTICAL CONSULTING FOR LEHD AUDIT (Economic Project TBA)

Description: Our center staff will assist Economic Directorate staff with an internal audit of the Longitudinal Employer-Household Dynamics (LEHD) program, as needed, when specific statistical knowledge outside of the auditors' area of expertise is required to determine compliance with Office of Management and Budget (OMB) and Census Bureau standards.

Highlights: In FY 2013, staff initiated involvement in this project and saw this project to its conclusion. Staff attended meetings with Economic Directorate staff about the audit process, attended a pre-audit meeting with Center for Economic Studies (CES) and Economic Directorate staff, assisted the Economic Directorate staff in auditing LEHD methodological documentation related to imputation and synthetic data, contributed to the final audit report, and attended the final audit meeting. Work on this project is considered complete.

Staff: Darcy Steeg Morris (x33989), Andrea Chamberlain (Economic Directorate)

1.20 PROGRAM DIVISION OVERHEAD (Census Bureau Project 0381000)

A. Center Leadership and Support
This staff provides ongoing leadership and support for the overall collaborative consulting, research, and administrative operation of the center.

Staff: Tommy Wright (x31702), Alisha Armas, Michael Hawkins, Michael Leibert, Erica Magruder, Joe Schafer, Eric Slud, Kelly Taylor, Sarah Wilson

B. Research Computing
Description: This ongoing project is devoted to ensuring that Census Bureau researchers have the computers and software tools they need to develop new statistical methods and analyze Census Bureau data.

Highlights: During FY 2013, the IT High Performance Computing (HPC) project team planned and executed tests of various products related to grid management, job scheduling, and storage management, which we view as key functional areas of an HPC solution. The team looked at three job schedulers: Platform LSF, PBSPro, and MRG, and three shared filesystems: GPFS, Gluster, and Lustre. After learning more about Gluster, the IT Directorate decided to drop Gluster from the test schedule and to devote more time to testing GPFS. Testing was conducted in three phases: Platform LSF with GPFS, MRG with GPFS, and PBSPro with Lustre. In each phase, the products were scored against predetermined criteria.

While the various job schedulers and file systems had overlapping functionality, each had their own strengths and weaknesses. For example, Platform LSF had a feature to assign a task to a particular set of processors (processor affinity), which could be used to "sandbox" jobs. PBSPro lacked a similar feature but had other resource control mechanisms built in and was much easier to configure and use. The Computer Services Division (CSVD) found that while Lustre might provide potentially better performance in very large capacities, that it would require considerable additional hardware and would be more complex to implement than GPFS. GPFS also had stronger "high availability" features than Lustre. Based on the results of lab testing, the team chose PBSPro and GPFS as the job scheduler and shared filesystem for building ADRM's next research computing system. The project will now move into "preproduction" testing outside the lab on the Census Bureau's internal network. These "real world" tests will be performed by Census Bureau employees, using data from the Census Bureau. Preproduction testing is scheduled to be completed during the next fiscal year.

Staff: Chad Russell (x33215)

2. RESEARCH

2.1 GENERAL RESEARCH AND SUPPORT (Census Bureau Project 0351000)

2.2 GENERAL RESEARCH (Census Bureau Project 1871000)

Missing Data, Edit, and Imputation

Motivation: Missing data problems are endemic to the conduct of statistical experiments and data collection projects. The instigators almost never observe all the outcomes they had set to record. When dealing with sample surveys or censuses that means individuals or entities in the survey omit to respond, or give only part of the information they are being asked to provide. In addition the information provided may be logically inconsistent, which is tantamount to missing. To compute official statistics, agencies need to compensate for missing data. Available techniques for compensation include cell adjustments, imputation and editing. All these techniques involve mathematical modeling along with subject matter experience.

Research Problems: Compensating for missing data typically involves explicit or implicit modeling. Explicit methods include Bayesian multiple imputation and propensity score matching. Implicit methods revolve around donor-based techniques such as hot-deck imputation and predictive mean matching. All these techniques are subject to edit rules to ensure the logical consistency of remedial product. Research on integrating together statistical validity and logical requirements into the process of imputing continues to be challenging. Another important problem is that of correctly quantifying the reliability of predictors that have been produced in part through imputation, as their variance can be substantially greater than that computed nominally.

Potential Applications: Research on missing data leads to improved overall data quality and predictors accuracy for any census or sample survey with a substantial frequency of missing data. It also leads to methods to adjust the variance to reflect the additional uncertainty created by the missing data. Given the ever rising cost of conducting censuses and sample surveys, imputation and other missing-data compensation methods may come to replace actual data collection, in the future, in situations where collection is prohibitively expensive.

A. Editing

Description: This project covers development of methods for statistical data editing. Good methods allow us to produce efficient and accurate estimates and higher quality microdata for analyses.

Highlights: In FY2013, staff researched selective editing for our foreign trade data. We developed a score function that includes two separate measures: a measure of how suspicious a record is and the potential impact the suspicious record has on final estimated totals. We found the measure of the potential impact a given record has on estimated totals does not work as well when using the full data set. In this case, the size of the domain for computing totals is too large, except at the lowest levels of aggregations. Thus, the impact of any given record on the estimated totals within the domain becomes too small, as the estimated totals grow very large. We developed a separate score function that does not include a measure for potential impact; rather we compute a measure of the anticipated error in the variables and consider a global score function based on how suspicious a record is and the size of the anticipated error. We also revised previous research and existing computer programs for generating implied ratio edits. The revised software uses a shortest path algorithm to generate implied ratios in which a directed graph is used to represent the variables and edits. We updated the code for producing audit trails in the SAS/IML version of the computer program.

Staff: Maria Garcia (x31703)

B. Editing and Imputation

Description: Under this project, our staff provides advice, develops computer edit/imputation systems in support of demographic and economic projects, implements prototype production systems, and investigates edit/imputation methods.

Highlights: In FY 2013, staff developed interviewer response rate standards in our largest surveys. Staff developed an Excel tool for Field Headquarters and the Regional Directors to use to examine the effects of switching to the new methodology. We theoretically investigated decision rules in the context of adaptive design for application in the National Institute of Health Sciences (NIHS) survey and other demographic surveys. We continued to work on methods to impute missing data based on historical and administrative information in the context of the Survey of Income and Program Participation (SIPP).

We wrote specifications for a truth-deck to evaluate the quality of the edits and imputations for the household characteristics for several edit-imputation methods under evaluation for Census 2020, documenting edit rules and various imputation methods considered for the Census. Staff consulted with the Population Division on metrics in preparation for Census 2020.

Staff: Yves Thibaudeau (x31706), Maria Garcia, Martin Klein, Darcy Steeg Morris

C. Missing Data and Imputation: Multiple Imputation Feasibility Study

Description: Methods for imputing missing data are closely related to methods used for synthesizing sensitive items for disclosure limitation. One method currently applied to both issues is multiple imputation. Although the two issues may be addressed separately, techniques have been developed that allow data users to analyze data in which both missing data imputation and disclosure limitation synthesis have been accomplished via multiple imputation techniques (e.g., synthetic data). This project ascertains the effectiveness of applying multiple imputation to both missing data and disclosure limitation in the American Community Survey (ACS) group quarters data. Statistical models are used to generate several synthetic data sets for use within the multiple-imputation framework.

Highlights: In FY 2013, staff completed and delivered a report on the research on multiple imputation techniques applied to imputing earnings in the Survey of Income and Program Participation (SIPP). The report shows results for the implementation of non-parametric multiple imputation using the R-software *Tea*. It also includes results on implementing the *R* package *mi* in the context of production of a large periodic survey.

Staff: Rolando Rodriguez (x31816), Ben Klemens, Yves Thibaudeau

Record Linkage

Motivation: Record linkage is intrinsic to efficient, modern survey operations. It is used for unduplicating and updating name and address lists. It is used for applications such as matching and inserting addresses for geocoding, coverage measurement, Primary Selection Algorithm during decennial processing, Business Register unduplication and updating, re-identification experiments verifying the confidentiality of public-use microdata files, and new applications with groups of administrative lists. Significant theoretical and algorithmic progress (Winkler 2004ab, 2006ab, 2008, 2009a; Yancey 2005, 2006, 2007, 2011) demonstrates the potential for this research. For cleaning up administrative records files that need to be linked, theoretical and extreme computational results (Winkler 2010, 2011b) yield methods for editing, missing data and even producing synthetic data with valid analytic properties and reduced/eliminated re-identification risk. Easy means of constructing synthetic data make it straightforward to pass files among groups.

Research Problems: The research problems are in three major categories. First, we need to develop effective ways of further automating our major record linkage operations. The software needs improvements for matching large sets of files with hundreds of millions records against other large sets of files. Second, a key open research question is how to effectively and automatically estimate matching error rates. Third, we need to investigate how to develop effective statistical analysis tools for analyzing data from groups of administrative records when unique identifiers are not available. These methods need to show how to do correct demographic, economic, and statistical analyses in the presence of matching error.

Potential Applications: Presently, the Census Bureau is contemplating or working on many projects involving record linkage. The projects encompass the Demographic, Economic, and Decennial areas.

A. Disclosure Avoidance for Microdata

Description: Our staff investigates methods of microdata masking that preserves analytic properties of public-use microdata and avoid disclosure.

Highlights: Staff reviewed several record linkage papers where the methods were used for re-identification purposes; we reviewed some of the literature (lack of) of justifying the analytic properties of synthetic data. After determining a narrow range of situations for which files can be determined to be "fit for use," we hope to use our *DISCRETE* modeling/edit/imputation software to generate synthetic data with reduced/eliminated re-identification risk and valid analytic properties. The modeling methods in *DISCRETE* may serve as a possible alternative or supplement to differential privacy that still needs extension to providing valid analytic properties. An advantage of *DISCRETE* is its ease-of-use by relatively junior analysts and programmers and its extreme computational speed making it suitable for national files. Staff at Cornell are testing *DISCRETE* on a contingency table with 2 billion cells. We are currently unaware of loglinear modeling methods/software for contingency tables with missing data with size of 500,000 cells.

Staff reviewed additional literature on differential privacy and one paper on the use of estimating equations for doing analyses on masked or synthetic data. Staff refereed two papers for statistical journals. One staff member continued as Associate Editor of two computer science journals related to privacy and confidentiality. One staff member is on the program committee for Statistical Data Protection 2014.

Staff: William Winkler (x34729), William Yancey, Joshua Tokle

B. Development and Evaluation of Methodology for Statistical Disclosure Control

Description: When survey organizations release data to the public, a major concern is the protection of individual records from disclosure while maintaining quality and

utility of the released data. Procedures that deliberately alter data prior to their release fall under the general heading of statistical disclosure control. This project develops new methodology for statistical disclosure control, and evaluates properties of new and existing methods. We develop and study methods that yield valid statistical analyses, while simultaneously protecting individual records from disclosure.

Highlights: Work completed in FY 2013 is as follows. First, staff continued work on the development of a new method to simplify the analysis of noise multiplied univariate data using multiple imputation techniques. Staff (a) performed some empirical work to study the amount of privacy protection provided by this new method, (b) initiated theoretical work to extend this methodology to the case of multivariate data, and (c) performed a preliminary comparison of this method with the synthetic data method. Staff revised a paper to include the new results, and to address other comments received from the referees. The paper was accepted for publication in the *Journal of Official Statistics.*

Second, staff continued work on the development of likelihood based methods to analyze univariate data coming from either a normal, log-normal, or exponential population, where each original observation is perturbed by multiplicative noise for the purpose of statistical disclosure control. A likelihood based method of data analysis was developed for noise multiplied data from each of these three populations, and the accuracy of the resulting inference was assessed through simulation studies. Because synthetic data methods are already available for statistical disclosure control of each original observation, some comparisons with the propsed method were made through a simulation study. A paper describing this work was prepared, submitted for publication, revised based on referee's comments, and accepted for publication in the *Journal of the Thai Statistical Association*.

Third, staff continued work on the development of a likelihood based method to analyze log-normally distributed data where any large value (exceeding a fixed threshold) is perturbed by multiplicative noise for the purpose of statistical disclosure control. For income data it is common for the large values to require privacy protection, and because income data are often log-normally distributed, we have focused on the log-normal in the present study. A likelihood based method was developed to analyze the privacy protected data under two types of data releases: (i) each released value includes an indicator of whether or not it has been noise multiplied, and (ii) no such indicator is provided. Through simulation study, the accuracy of inference under the proposed method was assessed. Because top coding and synthetic data methods are already available as disclosure control strategies for extreme values, some comparisons with the proposed method were made through a simulation study. Results under the proposed method were illustrated using an example from 2000 U.S. Current Population Survey data. Staff prepared a manuscript based on this work, and submitted it to a journal for publication.

Fourth, staff performed theoretical work toward the development of new and exact methods for drawing inference based on synthetic (multiply imputed) data. Staff obtained exact and in some cases optimal estimators and confidence intervals under the univariate normal and exponential parametric models when synthetic data are drawn from (a) the posterior predictive distribution and (b) the parametric model for the population with unknown parameters replaced by point estimates. Case (a) is referred to as posterior predictive sampling, and case (b) is referred to as plug-in sampling. Comparisons were made between posterior predictive sampling and plug-in sampling based on accuracy of the resulting inference. Plug-in sampling was found to generally lead to more accurate inference. A manuscript describing this work is currently under preparation.

Staff: Martin Klein (x37856), Bimal Sinha (CDAR), Thomas Mathew

C. Record Linkage and Analytic Uses of Administrative Lists

Description: Under this project, staff will provide advice, develop computer matching systems, and develop and perform analytic methods for adjusting statistical analyses for computer matching error.

Highlights: In FY 2013, staff continued to provide advice and software to individuals in the Decennial Statistical Studies Division (DSSD), Center for Administrative Records Research & Applications (CARRA), Social, Economic, and Housing Statistics Division (SEHSD), Demographic Statistical Methods Division (DSMD), and Center for Economic Studies (CES). Staff in SEHSD created *SAS Proc BigMatch* around *BigMatch* that makes it suitable for certain Census Bureau applications. Two university groups and at least one group in the Census Bureau had previously failed to build a SAS shell around *BigMatch*. SEHSD has already provided *Proc BigMatch* to two other groups within the Census Bureau.

Staff provided background information on record linkage and distributed *BigMatch* software plus documentation to a number of university groups and to several government agencies around the world. In a three-year comparison of *BigMatch* with five shareware and two commercial packages (Ferrante et al., 2012), *BigMatch* was determined to be the most accurate software for record linkage. Under special license, *BigMatch* has been adopted by several government entities, particularly health organizations. *BigMatch* continues as the fastest

record linkage software but now is only ten times as fast as Dedoop parallel software (Kolb and Rahm 2013). *BigMatch* continues to be about 500 times as fast as software used in some government agencies (Wright 2011).

Staff circulated the report "Cleaning and using administrative lists: Methods and fast computational algorithms for record linkage and modeling/editing/ imputation" along with background information to a number of groups around the world. The paper describes new generalized software and new computational algorithms first described in short courses at the University of London and then given (twice each) at the Census Bureau. The software has algorithms that are sufficiently fast for working on sets of national files. Details of the methods were described in talks at the Isaac Newton Institute in January and to the statistics and machine learning departments at Carnegie-Mellon University in March. Staff will give further talks on the methods at the 2013 *Federal Committee on Statistical Methodology* (FCSM) conference and at the Statistical and Applied Mathematical Sciences Institute (SAMSI) in January 2014.

Staff wrote three papers for the Joint Statistical Meetings (JSM). One paper was on using Markov Chain Monte Carlo (MCMC) methods for parameter estimation that staff compared to our basic Expectation Maximization (EM) methods. One paper investigated methods of error-rate estimation. A third paper looked at methods of adjusting statistical analyses on merged files for linkage error.

Staff: William Winkler (x34729), William Yancey, Ned Porter

D. Modeling, Analysis, and Quality of Data

Description: Our staff investigates methods of the quality of microdata primarily via modeling methods and new software techniques that accurately describe one or two of the analytic properties of the microdata.

Highlights: In FY 2013, staff did the following: one staff member is a member of a group at the Isaac Newton Institute that is providing advice to the government of the United Kingdom on "Data Analysis and Anonymisation" in the Social Sciences. The staff person gave the opening technical talk on data linkage (available at: http://www.newton.ac.uk/programmes/INI/iniw91.html). Census Bureau software – *BigMatch* and *DISCRETE* which were introduced in two short courses at the University of London – are of substantial interest because of their power and their extreme speed, with crucial components being on the order of 10 to 100 times faster than commercial and experimental university software. With the new generalized software, a group of ten to twenty suitably skilled individuals could clean-up, merge, and analyze a set of national files in one to three months. With slower software, it is not clear how long the work would take.

Staff continued to provide advice on text categorization, used for industry-and-occupation coding, to groups within and outside the Census Bureau. In particular, staff attended and provided advice at meetings of the Center of Applied Technology in the IT Directorate. Staff were able to point out that most optimization methods used in statistics and machine learning are not currently available in cloud-based environments, although there is significant research. *Hadoop* methods have not shown improvements for some of the key problems that the Census Bureau is currently facing. In particular, recent *Dedoop* methods (Kolb and Rahm 2013) that have very impressive automated load balancing methods for record linkage using *Hadoop* in cloud-based environments are still 10 times slower than *BigMatch*, but *Dedoop* is 4-50 times faster than experimental parallel record linkage software at some universities.

Staff provided extensive advice on modeling/edit/ imputation methods that apply the Fellegi-Sunter model of statistical data editing (*JASA* 1976). The SPEER system (Winkler 1995, Draper and Winkler 1997) has been used for production in the last four Economic Censuses with some breakthrough algorithms. Kovar and Winkler (1996) in comparing SPEER and Statistics Canada's GEIS system showed that SPEER is 60 times as fast as General Edit and Imputation System (GEIS) and both systems achieve above a 99.5% error localization rate (i.e., finding the minimum number of fields to impute). The speed breakthrough meant that the Census Bureau was able to process each of the Economic Censuses in 1997 in less than 12 hours. Because the Census Bureau had written some record linkage routines for Statistics Canada (STC), our division was given the right to use GEIS source code in developing some of systems but had to keep the source code confidential. Statistics Canada earlier commissioned a review of integer programming algorithms by William Pulleyblank (Waterloo, later head of IBM's parallel computation lab) who concluded that STC's version of the Chernikova Algorithm was slightly faster than an algorithm of his and far faster than conventional integer programming algorithms. Advice and comments were provided to researchers who are working on the five year National Science Foundation (NSF) grant that was awarded to Duke/ National Institute of Statistical Sciences (NISS). Staff will serve as discussant in a Federal Committee on Statistical Methodology (FCSM) session on edit/imputation/confidentiality by the researchers at DUKE/NISS.

Staff also provided extensive advice to the Duke/NISS group about methods of modeling/editing/imputing for discrete data and nuances of our *DISCRETE* system.

DISCRETE, which staff demonstrate with four Census Bureau examples in the modeling/edit/imputation course, is designed to be easily usable by relatively junior analysts and programmers. The keys to *DISCRETE*'s extreme speed, making it suitable for national files, were 100-fold improvements in four algorithms in the software.

In talks at the Isaac Newton Institute and at Carnegie-Mellon University, one of our center's staff described how Census Bureau methods can be used in cleaning up sets of national files – those for missing data, edit contradictions, and duplication – prior to merging using our *BigMatch* methods. The staff described current research, beginning with Scheuren and Winkler 1993, 1997; Lahiri and Larsen 2005 *JASA*, in methods for adjusting statistical analyses for linkage error. The staff person also described how methods from statistical matching and modeling/edit/imputation might further be used in cleaning up merged files. One staff member reviewed at long-range research proposal for the Isaac Newton Institute.

Staff: William Winkler (x34729), William Yancey, Joshua Tokle, Ned Porter, Maria Garcia

Small Area Estimation

Motivation: Small area estimation is important in light of a continual demand by data users for finer geographic detail of published statistics. Traditional demographic surveys designed for national estimates do not provide large enough samples to produce reliable direct estimates for small areas such as counties and even most states. The use of valid statistical models can provide small area estimates with greater precision, however bias due to an incorrect model or failure to account for informative sampling can result.

Research Problems:
• Development/evaluation of multilevel random effects models for capture/recapture models.
• Development of small area models to assess bias in synthetic estimates.
• Development of expertise using nonparametric modeling methods as an adjunct to small area estimation models.
• Development/evaluation of Bayesian methods to combine multiple models.
• Development of models to improve design-based sampling variance estimates.
• Extension of current univariate small-area models to handle multivariate outcomes.

Potential Applications:
• Development/evaluation of binary, random effects models for small area estimation, in the presence of informative sampling, cuts across many small area issues at the Census Bureau.
• Using nonparametric techniques may help determine fixed effects and ascertain distributional form for random effects.
• Improving the estimated design-based sampling variance estimates leads to better small area models which assumes these sampling error variances are known.
• For practical reasons, separate models are often developed for counties, states, etc. There is a need to coordinate the resulting estimates so smaller levels sum up to larger ones in a way that correctly accounts for accuracy.
• Extension of small area models to estimators of design-base variance.

A. Small Area Estimation
Description: Methods will be investigated to provide estimates for geographic areas or subpopulations when sample sizes from these domains are inadequate.

Highlights:
Using Small Area Models to Improve Survey Variances
In FY 2013, staff ran additional simulations to understand the biases in the Taylor approximation for the uncertainty of the replicate weight variance estimator for rate estimates. The simulations showed that the bias is a function of the underlying distribution. For small sample sizes, under 25 households, staff observed significant biases in the direct variance estimator. For sample sizes up to a few hundred, staff observed biases in the approximation of the uncertainty of the variance estimator. Because there is not a single systematic way to correct for the biases, the simulation should be calibrated to the specifics of the application to obtain the custom bias correction terms. Staff is currently developing the procedures to run the calibrated simulations to generate the bias correction terms.

Bayesian Inference Using a Design-Adjusted Likelihood
FY 2013, staff worked on the problem of approximating the likelihood with design-adjusted models which are simpler to work with through use of the design effect, and compared the approximation to the exact likelihood in special cases for small samples. This problem is particularly important for Bayesian small area modeling which requires specification of a likelihood and a prior distribution. Staff has submitted a research paper which is currently under review.

A Weighted Likelihood Approach to Model-based Small Area Estimation with Unit-level Data
Small area estimation uses area-level or unit-level models. Area-level models apply to direct survey estimates that are typically design consistent, leading to design consistent model predictions. Unit-level models, however, typically apply to survey microdata ignoring the sampling weights, not leading to design consistent model

predictions. Kott, Rao and others developed methods to incorporate sampling weights in the unit-level normal nested error regression model to achieve design consistency. Staff is considering several pseudo-likelihoods incorporating sampling weights that apply to normal or non-normal data, including binary and count data. Using a Bayesian approach, staff intends to apply our method to American Community Survey data. Staff presented preliminary results of the proposed method at the Annual Meeting of the Statistical Society of Canada. Based on comments from the meeting, staff will revise our method and apply the result to poverty data from the ACS.

A Finite Mixture Model to Accommodate Outliers in Area-level Small Area Models

Staff is considering a modification of the Fay-Herriot model, using a two-component mixture of normal distribution for the random small area effects, to account for outliers in the data. Staff proposes to carry out a non-informative hierarchical Bayesian approach and an empirical best linear unbiased estimation of small area means. Our method will provide a robust yet simple alternative to the widely used Fay-Herriot model in various Census Bureau small area estimation projects. Staff has recently obtained some methodological results and plans to apply this new method to its Small Area Income and Poverty Estimates (SAIPE) project.

A Bootstrap Approach to Small Area Estimation with Random Clusters

Staff is considering a bootstrap approach to partition a group of small areas with possible non-identical random small area effects in an attempt to build flexible small area estimation method. In problems with a large number of small areas, such as county level or school district level applications, the standard Fay-Herriot model may not provide a good fit. It is believed that the small areas can be partitioned into several subgroups or clusters where the small area effects within a cluster are exchangeable. Staff plans to adapt the multiple testing ideas to identify the clusters, and subsequently develop robust estimators of small area means. Additionally, staff plans to conduct the estimation after identification of clusters via bootstrap approach.

A Measurement Error Approach to Small Area Estimation

Staff prepared a manuscript by modifying the Fay-Herriot method of small area estimation when covariates are obtained from a related or a different survey. Such covariates are subject to large sampling variation leading to non-ignorable measurement error. Staff will present this at the 2013 Joint Statistical Meetings. Staff plans to apply this model in the Small Area Estimates of Disabilities Project which uses data from the ACS and the SIPP. By treating the ACS disability estimates as a covariate related to the SIPP estimates but subject to measurement (sampling) error, the formulation in the manuscript can be used to small area estimation of disability rates based on the SIPP measures of disability. Under certain scenarios, the new measurement error model becomes equivalent to a bivariate Fay-Herriot model.

Small Area Estimation of Payroll and Employment Characteristics

In the context of the Annual Survey of Public Employment and Payroll (ASPEP), the Governments Division is interested in accurate estimation of salaries and hours of full-time and part-time employees at the state level for different government types and function codes of the employing government units. Staff found out in an earlier data set that within each state and government type, significant reduction of the mean squared error of regression estimates is realized if some of the other variables from the previous census are also used. Staff anticipates that further gain in reduction of the MSE may be possible by including even some of the other variables from ASPEP. Staff intends to build a two-stage nested error regression model to investigate the extent of improvement over a standard univariate nested error regression model. Staff also intends to explore various decompositions of the small area random effects, when the small areas are defined by cross-classification of state and function type. Staff plans to consider both a hierarchical Bayes approach and an empirical best linear unbiased prediction approach.

Staff: Jerry Maples (x32873), Aaron Gilary, Ryan Janicki, Jerzy Wieczorek, Gauri Datta

B. Small Area Methods with Misspecification

Description: In this project, we undertake research on area-level methods with misspecified models, primarily directed at development of diagnostics for misspecification using robust sandwich-formula variances, cross-validation, and others, and on Bayesian estimation of model parameters within two-component Fay-Herriot models .

Highlights: In FY 2013, staff conducted several strands of research on area-level methods based on models extending the usual framework in which all areas follow the same mixed-effects model. The first approach had involved the possibility that the mixed-effects regression model is misspecified, and aimed at the development of diagnostics for misspecification using robust sandwich-formula variances and cross-validation. Discussions in this year concerned models allowing for different error-structures within the same overall regression-type model that would apply to distinct sets of small areas. On specific proposal along this line is a two-component mixture of normal distribution for the random small area effects, to account for outliers in the data. These discussions led to preliminary theoretical formulations

accommodating at least two different error- or mean-structures within Fay-Herriot models, and to Bayesian estimation of model parameters within such a multi-component structure. Staff prepared a paper and talk for the Joint Statistical Meetings on this research. Further research, including simulation studies, on frequentist diagnostics and Bayesian estimation within small area mixture models is continuing. The ultimate goal is to apply the methods developed to our center's Small Area Income and Poverty Estimates (SAIPE) project.

Staff: Eric Slud (x34991), Gauri Datta

C. Visualization of Small Area Estimates
Description: Methods are needed to display estimates for a large number of small areas or domains. Displays should accurately convey the level of statistical uncertainty and should guide readers in making comparisons appropriately between domains or over time. Part of this work overlaps with project 1.7.D "Assessing Uncertainty in ACS Ranking Tables" and Survey Sampling-Estimation and Modeling, D: "The Ranking Project: Methodology Development and Evaluation."

Highlights: In FY 2013, in conjunction with work in the overlapping projects named above, we reviewed existing methodology and developed new visual displays for simultaneously comparing point estimates and their resulting ranks from a large number of areas. These methods include: significance heatmaps; confidence intervals for differences; comparison intervals (Almond et al., 2000); independent confidence intervals with average significance level (Goldstein and Healy, 1995); and sparkline histograms.

Independently of other projects, we recreated existing and developed new visual displays of uncertainty in geographic maps. These methods include static and animated maps with pixel color distributions and an R version of David Wong's *ArcGIS* extension that shades maps to indicate significance of comparisons.

We created reproducible R scripts for each display method. We are preparing them to be packaged and disseminated for internal use and, ideally, released for public use. We developed and began testing a preliminary R package for dissemination of these display methods.

Staff: Jerzy Wieczorek (x35725), Derrick Simmons

Survey Sampling-Estimation and Modeling

Motivation: The demographic sample surveys of the Census Bureau cover a wide range of topics but use similar statistical methods to calculate estimation weights. It is desirable to carry out a continuing program of research to improve the accuracy and efficiency of the estimates of characteristics of persons and households. Among the methods of interest are sample designs, adjustments for non-response, proper use of population estimates as weighting controls, small area estimation, and the effects of imputation on variances.

The Economic Directorate of the Census Bureau encounters a number of issues in sampling and estimation in which changes might increase the accuracy or efficiency of the survey estimates. These include, but are not restricted to, a) estimates of low-valued exports and imports not currently reported, b) influential values in retail trade survey, and c) surveys of government employment.

The Decennial Census is such a massive undertaking that careful planning requires testing proposed methodologies to achieve the best practical design possible. Also, the U.S. Census occurs only every ten years and is the optimal opportunity to conduct evaluations and experiments with methodologies that might improve the next census. Sampling and estimation are necessary components of the census testing, evaluations, and experiments. The scale and variety of census operations require an ongoing research program to achieve improvements in methodologies. Among the methods of interest are coverage measurement sampling and estimation, coverage measurement evaluation, evaluation of census operations, uses of administrative records in census operations, improvements in census processing, and analyses that aid in increasing census response.

Research Problems:
• How can methods making additional use of administrative records, such as model-assisted and balanced sampling, be used to increase the efficiency of household surveys?
• Can non-traditional design methods such as adaptive sampling be used to improve estimation for rare characteristics and populations?
• How can time series and spatial methods be used to improve ACS estimates or explain patterns in the data?
• Can generalized weighting methods be implemented via optimization procedures that allow better understanding of how the various steps relate to each other?
• Some unusual outlying responses in the surveys of retail trade and government employment are confirmed to be accurate, but can have an undesired large effect on the estimates - especially estimates of change. Procedures for detecting and addressing these influential values are being extended and examined through simulation to measure their effect on the estimates, and to determine how any such adjustment best conforms with the overall system of estimation (monthly and annual) and benchmarking.

• What models aid in assessing the combined effect of all the sources of estimable sampling and nonsampling error on the estimates of population size?
• How can administrative records improve census coverage measurement, and how can census coverage measurement data improve applications of administrative records?
• What analyses will inform the development of census communications to encourage census response?
• How should a national computer matching system for the Decennial Census be designed in order to find the best balance between the conflicting goals of maximizing the detection of true duplicates and minimizing coincidental matches? How does the balance between these goals shift when modifying the system for use in other applications?
• What can we say about the additional information that could have been obtained if deleted census persons and housing units had been part of the Census Coverage Measurement (CCM) Survey?

Potential Applications:
• Improve estimates and reduce costs for household surveys via the introduction of additional design and estimation procedures.
• Produce improved ACS small area estimates through the use of time series and spatial methods.
• Apply the same weighting software to various surveys.
• New procedures for identifying and addressing influential values in the monthly trade surveys could provide statistical support for making changes to weights or reported values that produce more accurate estimates of month-to-month change and monthly level. The same is true for influential values in surveys of government employment.
• Provide a synthesis of the effect of nonsampling errors on estimates of net census coverage error, erroneous enumerations, and omissions and identify the types of nonsampling errors that have the greatest effects.
• Describe the uncertainty in estimates of foreign-born immigration based on American Community Survey (ACS) used by Demographic Analysis (DA) and the Postcensal Estimates Program (PEP) to form estimates of population size.
• Improve the estimates of census coverage error.
• Improve the mail response rate in censuses and thereby reduce the cost.
• Help reduce census errors by aiding in the detection and removal of census duplicates.
• Provide information useful for the evaluation of census quality.
• Provide a computer matching system that can be used with appropriate modifications for both the Decennial Census and several Decennial-related evaluations.

A. Survey Productivity and Cost Analysis
Description: The Survey Productivity and Cost Analysis (SPCA) Group has been established as a cross-directorate analytic team to conduct methodological research toward the goal of continuous improvement in survey operational efficiency. The group will both initiate and respond to issues related to survey performance indicators including cost, data quality, and data collection progress, as they relate to survey design. Our Center is represented on this team along with other staff from the Research and Methodology Directorate, the Demographic Programs Directorate, the Decennial Directorate, the Center for Economic Studies (CES), the Field Directorate, and the Center for Survey Measurement (CSM).

Highlights: In FY 2013, we developed and implemented new methodology for setting response rate standards in surveys conducted by the Census Bureau, working with Field Headquarters and Regional Directors. In addition, the Survey Productivity and Cost Analysis (SPCA) team worked with staff in the Research and Methodology Directorate to develop response propensity models for the American Housing Survey and to design a dashboard for the Universal Tracking System that displayed daily case-level response propensities throughout the 5-month survey field period. Management of the regional offices used the dashboard to direct daily survey operations.

The SPCA team also established subgroup to simulate possibilities for adaptive design in our surveys. The adaptive sampling simulation subgroup designed simulations for the National Health Interview Survey and completed preliminary assessments of the tradeoff between cost and quality of key survey estimates under various stopping rules.

Staff: Chandra Erdman (x31235)

B. Household Survey Design and Estimation
[See Project 5385260, Decennial Directorate – American Community Survey (ACS) page 6.]

C. Sampling and Estimation Methodology: Economic Surveys
Description: The Economic Directorate of the Census Bureau encounters a number of issues in sampling and estimation in which changes might increase the accuracy or efficiency of the survey estimates. These include estimates of low-valued exports not currently reported, alternative estimation for the *Quarterly Financial Report*, and procedures to address nonresponse and reduce respondent burden in the surveys. Further, general simulation software might be created and structured to eliminate various individual research efforts. An observation is considered influential if the estimate of total monthly revenue is dominated by its weighted contribution. The goal of the research is to find methodology that uses the observation but in a manner that assures its contribution does not dominate the estimated total or the estimates of period-to-period change.

Highlights: In FY 2013, staff continued collaboration with a team in the Economic Directorate on research to find a statistical procedure for detecting and treating verified influential values in economic surveys to replace the current subjective procedure performed by analysts. Recent research has focused on finding an automated procedure with the expectation that any adjustments would be reviewed. Previous research identified an M-estimation methodology as the most suitable choice. Previous research also found that initial parameter settings for the M-estimation algorithm affected its performance.

Staff developed a general methodology that uses historical data to determine the initial parameter settings for the M-estimation algorithm parameters. The methodology has the flexibility to accommodate a wide variety of economic data, which is usually highly skewed and therefore highly stratified, and. to account for seasonal effects. Simulations showed that using the new methodology to choose parameters for the M-estimation algorithm identified influential values appropriately and created adjustments that reduce bias and achieve the lowest estimated MSE of the estimated total. Staff has documented the method for setting parameters to facilitate its use in side-by-side testing. The team is using the research results to prepare M-estimation parameters settings for a side-by-side test with 19 industries in the Monthly Wholesale Trade Survey (MWTS) that will conducted in real time during MWTS data collection in the last few months of calendar year 2013 and into 2014.

Staff: Mary Mulry (x31759)

D. The Ranking Project: Methodology Development and Evaluation

Description: This project undertakes research into the development and evaluation of statistical procedures for using sample survey data to rank several populations with respect to a characteristic of interest. The research includes an investigation of methods for quantifying and presenting the uncertainty in an estimated ranking of populations. As an example, a series of ranking tables are released from the American Community Survey in which the fifty states and the District of Columbia are ordered based on estimates of certain characteristics of interest.

Highlights: In FY 2013, staff documented, improved some theory for, and developed software and visualizations for seven simple and useful methods and illustrated their use in expressing uncertainty in ranking *k* populations based on data from sample surveys. In general, we assume a collection of *k* populations with *k* independent survey estimates and associated standard errors. These *k* estimates and *k* standard errors form the basis of everything we considered. One major category of methods focused on visually comparing pairs of states using normal theory presenting uncertainty in the estimated ranking through the use of confidence intervals and hypothesis tests for individual parameters for each unit (state) in a ranking, and for the pairwise difference in the parameters for two states: (1) comparing one reference state against each of the other states, (2) comparing one reference state against each of the other states showing confidence intervals for differences, (3) comparing one reference state using its confidence interval with each of the other states using their "comparison intervals," and (4) comparing a pair of states by presenting overlapping/non-overlapping confidence intervals appropriately for each state in the pair. The other major category of methods focused on the use of the bootstrap. In particular, we considered the individual ranks as the parameters on interest, and considered the approach of drawing inferences on the ranks directly. Three uncertainty measures were introduced and investigated in the context of the bootstrap (parametric as well as nonparametric): (1) a collection of *k* confidence intervals for the unknown true ranks, (2) a collection of *k* estimates of the probabilities that the estimated rank for a specific state within *c* units of the true rank of that state (where "*c*" is a positive, real number), and (3) joint probabilities for all *k* states.

These seven methods were illustrated using 2011 ACS published estimates and standard errors. By use of an example, we also introduced the concept of "a most probable ranking" inspired by classical nonparametric methods. Details are presented in a draft manuscript "An Overview of Some Concepts for Potential Use in Ranking Populations Based on Sample Survey Data" (see also ACS Project 5385260-D). Results were presented at the International Statistical Institute's 59th World Statistics Congress. Staff discussed the topic of visualizing rankings with a *SUMMER AT CENSUS* scholar.

Staff: Tommy Wright (x31702), Martin Klein, Jerzy Wieczorek, Derrick Simmons

E. Statistical Design for 2020 Planning, Experimentation, and Evaluations

Description: The purpose of this project is to investigate the use of social network methodology, tools, and software in the planning, preparation, and implementation of the decennial census, while reducing costs and maintaining quality.

Highlights: In FY 2013, staff met with the Census 2020 Research and Planning Office (20RPO) Market Research Team to discuss ongoing efforts in identifying commercial products and services with expertise in social networking to enhance Census 2020 operations. The Market Research Team planned and hosted the Census Bureau/Dept. of Defense Rapid Reaction Technology Office (RRTO) Solutions Workshop, held at Census

Headquarters. Our center's staff consulted with the Market Research Team to advertise and prepare for the Solutions Workshop, as well as provide support during follow-up vendor meetings with social media venture capitalists.

Staff: Taniecea Arceneaux (x33440)

F. Sampling and Apportionment
Description: This short-term effort demonstrated the equivalence of two well-known problems – the optimal allocation of the fixed overall sample size among L strata under stratified random sampling and the optimal allocation of the H=435 seats among the 50 states for the apportionment of the U.S. House of Representatives following each decennial census.

Highlights: In FY 2013, staff continued to investigate the new exact optimum sample allocation algorithm (Wright 2012) for stratified random sampling subject to a wide variety of constraints on the strata sample sizes for fixed overall sample size, including a consideration of different costs among the strata. We also proved directly the equivalence of the apportionment method of Webster and the apportionment method of Wilcox.

Staff: Tommy Wright (x31702), Pat Hunley

G. Interviewer-Respondent Interactions: Gaining Cooperation
Description: Survey nonresponse rates have been increasing, leading to concerns about the accuracy of (demographic) sample survey estimates. For example, from 1990 to 2004, initial contact nonresponse rates have approximately doubled for selected household sample surveys including the Current Population Survey (CPS) (from 5.7 percent to 10.1 percent). While mailout/mailback is a relatively inexpensive data collection methodology, decreases in mailback rates to censuses and sample surveys mean increased use of methodologies that bring respondents into direct contact with Census Bureau interviewers (e.g., field representatives) using CATI (computer assisted telephone interviewing) or CAPI (computer assisted personal interviewing). CAPI can include face-to-face or telephone contact. Unsuccessful interviewer-respondent interactions can lead to increased costs due to the need for additional follow-up, and can also decrease data quality. So, unsuccessful interviewer-respondent interactions should be minimized.

This project will analyze data from 512 field representatives (interviewers) as part of an exploratory study, examining their beliefs regarding what works in gaining respondents' cooperation and investigating associations with field representatives' performance in terms of completed interview rates. We will also study associations between field representatives' beliefs and what they say they do.

Highlights: In FY 2013, limited work on this project resumed. Staff demonstrated that there is empirical evidence of an association between field representatives' beliefs and what field representatives say that they do.

*S*ome limited analyses were performed to detect differences in responses among five different questionnaire types and to detect differences among the twelve regional offices. In general, few significant differences were found, and we will combine data for future analyses.

Staff: Tommy Wright (x31702), Tom Petkunas

Statistical Computing and Software

Motivation: Modern statistics and computing go hand in hand, and new statistical methods need to be implemented in software to be broadly adopted. The focus of this research area is to develop general purpose software using sound statistical methods that can be used in a variety of Census Bureau applications.

These application areas include: survey processing - editing, imputation, non-response adjustment, calibration and estimation; record linkage; disclosure methods; time series and seasonal adjustment; variance estimation; small-area estimation; and data visualization, exploratory data analysis and graphics. Also see the other sections in this document for more detail on some of the topics.

Research Problems:
- Investigate the current best and new statistical methods for each application.
- Investigate alternative algorithms for statistical methods.
- Determine how to best implement the statistical algorithms in software.

Potential Applications:
- Anywhere in the Census Bureau where statistical software is used.

A. Software Development (*Tea*)
[See decennial project (J) Software Development (*Tea*) page 4.]

B. R Users Group
Description: The initial objective of the R User group is to identify the areas of the Census Bureau where R software is developed and those other areas that could benefit from such development. The scope of the topics is broad and it includes estimation, missing data methods, statistical modeling, Monte-Carlo and resampling

methods. The ultimate goal is to move toward integrated R tools for statistical functionality at the Census Bureau.

Initially the group will review basic skills in R and provide remedial instruction as needed. The first topic for deeper investigation is complex-survey infrastructure utilities, in particular an evaluation of the "Survey Package" and its relevance at the Census Bureau in the context of weighing, replication, variance estimation and other structural issues.

Highlights: In FY 2013, staff met with officers and contractors from the Chief Technology Office (CTO). As a result, R has been approved by the Census Bureau's Standards Working Group (SWG).

Staff: Yves Thibaudeau (x31706) Chad Russell

Time Series and Seasonal Adjustment

Motivation: Seasonal adjustment is vital to the effective presentation of data collected from monthly and quarterly economic surveys by the Census Bureau and by other statistical agencies around the world. As the developer of the *X-12-ARIMA* Seasonal Adjustment Program, which has become a world standard, it is important for the Census Bureau to maintain an ongoing program of research related to seasonal adjustment methods and diagnostics, in order to keep *X-12-ARIMA* up-to-date and to improve how seasonal adjustment is done at the Census Bureau.

Research Problems:
• All contemporary seasonal adjustment programs of interest depend heavily on time series models for trading day and calendar effect estimation, for modeling abrupt changes in the trend, for providing required forecasts, and, in some cases, for the seasonal adjustment calculations. Better methods are needed for automatic model selection, for detection of inadequate models, and for assessing the uncertainty in modeling results due to model selection, outlier identification and non-normality. Also, new models are needed for complex holiday and calendar effects.
• Better diagnostics and measures of estimation and adjustment quality are needed, especially for model-based seasonal adjustment.
• For the seasonal, trading day and holiday adjustment of short time series, meaning series of length five years or less, more research into the properties of methods usually used for longer series, and perhaps into new methods, are needed.

Potential Applications:
• To the effective presentation of data collected from monthly and quarterly economic surveys by the Census Bureau and by other statistical agencies around the world.

A. Seasonal Adjustment
Description: This research is concerned with improvements to the general understanding of seasonal adjustment and signal extraction, with the goal of maintaining, expanding, and nurturing expertise in this topic at the Census Bureau.

Highlights: In FY 2013, staff (a) implemented a method to fit time series models such that signal extraction revisions are minimized, and began testing this method against conventional parameter estimates on real and simulated time series; joint work with the Economic Directorate; (b) continued investigating the direct filter approach to signal extraction and seasonal adjustment, by looking at adjustment filters with localized spectral seasonal troughs; and (c) continued numerical exploration of a seasonal adjustment method for mixed frequency time series.

Staff: Tucker McElroy (x33227), James Livsey, Brian Monsell

B. Time Series Analysis
Description: This research is concerned with broad contributions to the theory and understanding of discrete and continuous time series, for univariate or multivariate time series. The goal is to maintain and expand expertise in this topic at the Census Bureau.

Highlights: In FY 2013, staff (a) continued work on the primary alias filter discretization method for converting continuous-time signal extraction filters into discrete filters appropriate for stock or flow time series; joint work with the Federal Reserve Board; (b) continued theoretical and empirical work on spectral density estimation theory using fixed bandwidth ratio asymptotics, with a development of vanishing bandwidth as well. R code was written to compute the statistics and their limiting distributions; (c) continued work on stable parametrizations of vector autoregressive time series models, and performed numerical studies of performance; (d) derived recurrence relations among autocovariances and crosscovariances of data and volatility series for GARCH processes; and (e) completed numerical studies and revisions to a paper on fitting vector autoregressive models with constrained parameters.

Staff: Tucker McElroy (x33227), David Findley, James Livsey

Experimentation, Simulation, and Modeling

Motivation: Experiments at the Census Bureau are used to answer many research questions, especially those related to testing, evaluating, and advancing survey methods. A properly designed experiment provides a valid, cost-effective framework that ensures the right type

of data is collected as well as sufficient sample sizes and power are attained to address the questions of interest. The use of valid statistical models is vital to both the analysis of results from designed experiments and in characterizing relationships between variables in the vast data sources available to the Census Bureau. Statistical modeling is an essential component for wisely integrating data from previous sources (e.g., censuses, sample surveys, and administrative records) in order to maximize the information that they can provide. Monte Carlo simulation techniques aid in the design of complicated experiments as well as the evaluation of complex statistical models.

Research Problems:
• Develop models for the analysis of measurement errors in Demographic sample surveys (e.g., Current Population Survey or the Survey of Income and Program Participation).
• Develop methods for designed experiments embedded in sample surveys. Simulation studies can provide further insight (as well as validate) any proposed methods.
• Assess feasibility of established design methods (e.g., factorial designs) in Census Bureau experimental tests.
• Identify and develop statistical models (e.g., loglinear models, mixture models, and mixed-effects models) to characterize relationships between variables measured in censuses, sample surveys, and administrative records.
• Assess the applicability of post hoc methods (e.g., multiple comparisons and tolerance intervals) with future designed experiments and when reviewing previous data analyses.

Potential Applications:
• Modeling approaches with administrative records can help enhance the information obtained from various sample surveys.
• Experimental design can help guide and validate testing procedures proposed for the 2020 census.
• Expanding the collection of experimental design procedures currently utilized with the ACS.

A. Synthetic Survey and Processing Experiments
Description: To improve operational efficiencies and reduce costs of survey processing, this project will simulate a survey, in which an artificial team of interviewers seek out an artificial set of respondents, to test alternative methods of allocating resources in the field and to test alternatives for the post-processing of the gathered survey data. When calibrated with survey paradata, the model may also serve as a test bed for new methods of missing data imputation.

Highlights: In FY 2013, we provided supervision and advice to the MITRE Corporation, a Federally Funded Research and Development Center (FFRDC), in its implementation of an agent-based model of the decennial census process and the Census Bureau's post-mailback enumeration strategies (e.g., telephone or in-person follow-up, administrative records, and model-based imputation methods). We provided guidance on the design of MITRE's code base, which binds together blocks of code written by Census Bureau employees.

Staff: Ben Klemens (x36864)

B. Improved Nonparametric Tolerance Intervals
Description: Nonparametric tolerance intervals can be used for a set of univariate data where no reasonable distributional assumption is made. For the nonparametric setup, tolerance intervals are typically constructed from the order statistics based on an independent and identically distributed sample. However, two primary issues with this approach are (i) the tolerance interval is typically conservative, thus resulting in wider intervals, and (ii) for a fixed sample size, there may not exist order statistics that satisfy the conditions of a tolerance interval. Interpolation and extrapolation procedures are proposed to handle these issues. For planning purposes and cost evaluations, various projects conducting test surveys (e.g., the American Community Survey) could benefit from calculating these improved nonparametric tolerance intervals for projecting statistical bounds on various characteristics measured by the survey (e.g., household income).

Highlights: In FY 2013, we conducted extensive simulation studies to show the improvement in coverage probabilities when interpolating or extrapolating nonparametric limits based on order statistics. We submitted a revised manuscript of this work.

Staff: Derek Young (x36347), Thomas Mathew

C. Ratio Edits Based on Statistical Tolerance Intervals
Description: Ratio edit tolerances are bounds used for identifying errors in the data obtained by Economic Census Programs so that they can be flagged for further review. The tolerances represent upper and lower bounds on the ratio of two highly correlated items, and the bounds are used for outlier detection; i.e., to identify units that are inconsistent with the rest of the data. A number of outlier detection methods are available in the literature and can be used for developing ratio edit tolerances; however, statistical tolerance intervals have not been employed in the literature. This project is focused on the application of statistical tolerance for setting ratio edit tolerances.

Highlights: In FY 2013, staff developed an approach to properly apply statistical tolerance intervals when setting ratio edit tolerances. Staff focused on the setting of normal-based tolerance intervals when errors are believed

to be in both tails of the ratio distribution and Weibull-based tolerance intervals when the errors are believed to be in only one tail of the ratio distribution. Staff also applied their approach to data from the Annual Survey of Manufacturers. This research was presented at the 2013 Joint Statistical Meetings and a manuscript was submitted. Staff also began research towards the multivariate setting.

Staff: Derek Young (x36347), Thomas Mathew

D. Data Visualization Study Group

Description: This group meets to keep up to date with data visualization classes and events around the Census Bureau; to give each other feedback on ongoing projects; and to share advice on navigating the approvals process for visualization products that do not fall under standard classifications such as report, poster, etc.

Highlights: In FY 2013, the cross-divisional group was formed to discuss the content of a free online course taught by Alberto Cairo at the University of Miami. After the course, the group continued meeting to share lessons learned from other courses (such as Stephen Few's January 2013 workshop and Naomi Robbins' February and March 2013 courses at the Census Bureau) and as described above. Other lessons from visualization seminars and courses included lectures by Hadley Wickham in April and Alberto Cairo in May. We used the Center for Applied Technology (CAT) Lab for a demonstration of the simplified map-making/ visualization tool "Esri Maps For Office" and shared our experiences with related alternatives (Esri StoryMaps, JMP, etc.) that are approved for Census Bureau staff use.

Staff: Jerzy Wieczorek (x32248), Tiffany Julian (SEHSD), Tom Petkunas, Chandra Erdman

Summer at Census

Description: Recognized scholars in the following and related fields applicable to censuses and large-scale sample surveys are invited for short-term visits (one to ten days) primarily between May and September: statistics, survey methodology, demography, economics, geography, social and behavioral sciences, and computer science. Scholars present a seminar based on their research and engage in collaborative research with Census Bureau researchers and staff.

Scholars are identified through an annual Census Bureau-wide solicitation by the Center for Statistical Research and Methodology.

Highlights: In FY 2013, staff sponsored, with divisions around the Census Bureau, scholarly, short-term visits by 28 researchers who collaborated extensively with us and presented seminars on their research. For a list of the *2013 SUMMER AT CENSUS* scholars, see <http://www.census.gov/research/summer_at_census/summer_2013.php>. Their seminars are also noted in section 5 of this report.

Staff: Tommy Wright (x31702), Michael Leibert

Research Support and Assistance

This staff provides substantive support in the conduct of research, research assistance, technical assistance, and secretarial support for the various research efforts.

Staff: Alisha Armas, Erica Magruder, Kelly Taylor

3. PUBLICATIONS

3.1 JOURNAL ARTICLES, PUBLICATIONS

Findley, D., Monsell, B., and Hou, C. (2012). "Stock Series Holiday Regressors Generated from Flow Series Holiday Regressors," *Taiwan Economic Policy and Forecast 43(1)*, 71-118.

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Joyce, P. M., Malec, D., Little, R. J. A., Gilary, A., Navarro, A., and Asiala, M. E. (In Press). "Statistical Modeling Methodology for the Voting Rights Act Section 203 Language Assistance Determinations," *Journal of the American Statistical Association.*

Klein, M. and Linton, P. (2013). "On a Comparison of Tests of Homogeneity of Binomial Proportions," *Journal of Statistical Theory and Applications, 12*, 208-224.

Klein, M. and Sinha, B. (2013). "Statistical Analysis of Noise Multiplied Data Using Multiple Imputation," *Journal of Official Statistics, 29*, 425-465.

Klein, M., Mathew, T., and Sinha, B. (In Press). "Likelihood Based Inference Under Noise Multiplication," *Journal of the Thai Statistical Association.*

Lorenc, B., Loosveldt, G., Mulry, M. H., and Wrighte D. (2013). "Understanding and Improving the External Survey Environment of Official Statistics. Survey Methods: Insights from the Field," *Swiss Foundation for Research in Social Sciences.* Lausanne, Switzerland. Retrieved from <http://surveyinsights.org/?p=161>.

Mathew, T. and Young, D. (2013). "Fiducial-Based Tolerance Intervals for Some Discrete Distributions," *Computational Statistics and Data Analysis, 61*, 38-49.

McElroy, T. (2013) . "Forecasting Continuous-Time Processes with Applications to Signal Extraction," *Annals of the Institute of Statistical Mathematics, 65*, 439-456.

McElroy, T. and Holan, S. (2012). "A Conversation with David Findley," *Statistical Science 27*, 594-606.

McElroy, T. and Holan, S. (In Press). "Asymptotic Theory of Cepstral Random Fields," *Annals of Statistics*.

McElroy, T. and Jach, A. (2012). "Subsampling Inference for the Autocovariances of Heavy-Tailed Long-Memory Time Series," *Journal of Time Series Analysis 33*, 935-953.

McElroy, T. and Politis, D. (In Press). "Distribution Theory for the Studentized Mean for Long, Short, and Negative Memory Time Series," *Journal of Econometrics*.

McElroy, T. and Wildi, M. (2013). "Multi-Step Ahead Estimation of Time Series Models," *International Journal of Forecasting 29*, 378-394.

Shao, J., Slud, E., Cheng, Y., Wang, S., and Hogue, C. (In Press). "Theoretical and Empirical Properties of Model Assisted Decision-Based Regression Estimators," *Survey Methodology*.

Slud, E. and Suntornchost, J. (In Press), "Parametric Survival Densities from Phase-Type Models," in *Lifetime Data Analysis*.

Winkler, W. E. (2012). "Record Linkage," in *Encyclopedia of Environmetrics*, New York: John Wiley & Sons.

Wright, T. (In Press). "Lagrange's Identity and Congressional Apportionment," *The American Mathematical Monthly.*

Young, D. (In Press). "Mixtures of Regressions with Changepoints," *Statistics and Computing.*

Young, D. (2013). "Regression Tolerance Intervals," *Communications in Statistics - Simulation and Computation, 42(9),* 2040-2055.

Young, D. (In Press). "A Procedure for Approximate Negative Binomial Tolerance Intervals," *Journal of Statistical Computation and Simulation.*

Young, D. (2013). "Approximate Tolerance Limits for Zipf-Mandelbrot Distributions," *Physica A: Statistical Mechanics and Its Applications, 392(7),* 1702-1711.

3.2 BOOKS/BOOK CHAPTERS

Hogan, H. and Mulry, M. H. (In Press). "Assessing Accuracy of Postcensal Estimates: Statistical Properties of Different Measures," in N. Hogue (Ed.), *Emerging Techniques in Applied Demography.* Springer. New York, NY.

McElroy, T. and Pang, O. (In Press). "The Algebraic Structure of Transformed Time Series," in *Empirical Economic and Financial Research -- Theory, Methods, and Practice.*

McElroy, T. and Findley, D. (In Press). "Fitting Constrained Vector Autoregression Models," in *Empirical Economic and Financial Research -- Theory, Methods, and Practice.*

Mulry, M. H. (In Press). "Measuring Undercounts in Hard-to-Survey Groups," in *Hard-to-Survey Populations*, edited by R. Tourangeau, N. Bates, B. Edwards, T. Johnson, and K. Wolter, Cambridge University Press, Cambridge, England.

Schafer, J. L. (2013). "Bayesian Penalized Spline Models for Statistical Process Monitoring of Survey Paradata Quality Indicators," in *Improving Surveys with Paradata: Analytic Uses of Process Information*, edited by Frauke Kreuter, pp. 311-340. New York: Wiley.

3.3 PROCEEDINGS PAPERS

Joint Statistical Meetings, American Statistical Association, San Diego, CA, July 28 – August 2, 2012.
2012 Proceedings of the American Statistical Association

- Yang Cheng, Patrick Flanagan, and Eric Slud, "Overview of Current Population Survey Methodology," 3965-3979.
- David Findley, "Complementary Properties of an F-Test and an Empirical Spectral Test for Identifying Seasonality in Unadjusted or Seasonally Adjusted Series," 1067-1077.
- Carolina Franco and Partha Lahiri, "Interval Estimation for Small-Area Proportions with Small Time Proportions from Stratified Random Sampling Survey Data," 4386-4400.
- Aaron Gilary, Jerry Maples, and Eric Slud, "Small-Area Confidence Bounds on Small Cell Proportions in Survey Populations," 3542-3555.
- Sam Hawala, Ciara Nugent, and Jerzy Wieczorek, "A Bayesian Zero-One Inflated Beta Model for Small-Area Shrinkage Estimation," 3896-3910.
- Jerry Maples, "An Estimation of the Relative Variance of Replicate Variance Estimators for Rates Through First Order Expressions," 4068-4077.

- Mary Mulry, Broderick E. Oliver, and Stephen Kaputa, "Several Scenarios for Influential Observations in Business Surveys and Methods for Their Treatment," 4015-4029.

Proceedings of the 28th International Workshop on Statistical Modeling, Palermo, Italy, July 8 – 12, 2013.
- Darcy Steeg Morris, "A Semiparametric Approach for Multivariate Longitudinal Count Data," vol. 2, 707-712.

World Congress of Statistics, International Statistical Institute, Hong Kong, August 25 - August 31, 2013.
- Brian Monsell and Chris Blakely, "X-13ARIMA-SEATS and iMetrica."
- Tommy Wright, Martin Klein, and Jerzy Wieczorek, "An Overview of Some Concepts for Potential Use in Ranking Populations Based on Sample Survey Data."

3.4 CENTER FOR STATISTICAL RESEARCH & METHODOLOGY RESEARCH REPORTS

<http://www.census.gov/srd/www/byyear.html>

RR (Statistics #2013-01): Martin Klein and Bimal Sinha. "Statistical Analysis of Noise Multiplied Data Using Multiple Imputation," January 23, 2013.

RR (Statistics #2013-02): Martin Klein, Thomas Mathew, and Bimal Sinha. "A Comparison of Statistical Disclosure Control Methods: Multiple Imputation Versus Noise Multiplication," January 23, 2013.

RR (Statistics #2013-03): Martin Klein and Peter Linton. "On a Comparison of Tests of Homogeneity of Binomial Proportions," April 8, 2013.

RR (Statistics #2013-04): David F. Findley. "Model-Based Seasonal Adjustment Made Concrete with the First Order Seasonal Autoregressive Model." July 19, 2013.

RR (Statistics #2013-05): Tommy Wright. "A Visual Proof, a Test, and an Extension of a Simple Tool for Comparing Competing Estimates." September 10, 2013.

RR (Statistics #2013-06): Tucker McElroy and David Findley. "Fitting Constrained Vector Autoregression Models." September 25, 2013.

4. TALKS AND PRESENTATIONS

University of North Carolina at Greensboro, Greensboro, NC, October 5-7, 2012.
- Franco, Carolina, "Asymptotic Properties of Two Simple Semiparametric Estimates for a Case-Control Study Model."

Department of Mathematics and Statistics, University of Maryland Baltimore County, Baltimore, MD, October 12, 2012.
- Schafer, Joe, "Flexible Bayesian Models for Process Monitoring of Paradata Survey Quality Indicators."

Department of Statistics and Biostatistics, Rutgers University, Piscataway, NJ, October 17, 2012.
- Slud, Eric, "Small Area Confidence Bounds on Small Cell Proportions in Survey Populations."

2012 NBER-NSF Time Series Conference, Texas A&M University, College Station, TX, October 26-27, 2012.
- Findley, David, "Uncorrelatedness and Other Options for Differenced Seasonal Decomposition Components of Seasonal ARIMA Model Decompositions."
- McElroy, Tucker, "Multi-Step Ahead Forecasting of Vector Time Series."

2012 Conference on Surveying and Enumerating Hard-to-Reach Populations, New Orleans, LA, October 31-November 3, 2012.
- Mulry, Mary H., "Measuring Undercounts for Hard-to-Reach Groups." Invited.

Department of Statistics, Temple University, Philadelphia, PA, November 2, 2012.
- Klein, Martin, "Statistical Analysis of Noise Multiplied Data Using Multiple Imputation."

Department of Statistics, Michigan State University, East Lansing, MI, November 6, 2012.
- McElroy, Tucker, "Properties of an F-Test and Spectral Diagnostics for Detecting Seasonality in Unadjusted and Seasonally Adjusted Time Series" (Joint ongoing work with Demetra Lytras).

WESTAT, Rockville, MD, November 9, 2012.
- Slud, Eric, "Small Area Confidence Bounds on Small Cell Proportions in Survey Populations."

Department of Mathematics, Dickinson College, Carlisle, PA, November 13, 2012.
- Erdman, Chandra, "Predicting Response Propensities and Setting Response Rate Expectations in Large National Surveys."

2012 Federal Committee on Statistical Methodology (FCSM) Research Conference, Washington, DC, December 4-5, 2012.
- Joyce, Patrick, "Application of a Small-Area Model for a Voting Rights Act Tabulation."

Isaac Newton Institute, Cambridge University, Cambridge, UK, January 17, 2013.
- Winkler, William E., "Data Linkage: Issues and Overview of Methods."

Department of Statistics, Yale University, New Haven, CT, January 18, 2013.
- Erdman, Chandra, "Predicting the Difficulty of Census Enumeration for Small Geographies."

Department of Statistical Science, Duke University, Durham, NC, January 28, 2013.
- Klein, Martin, "Statistical Analysis of Noise Multiplied Data Using Multiple Imputation."

Department of Statistics, Columbia University, New York, NY, February 11, 2013.
- Wright, Tommy, "The Equivalence of Neyman Optimum Allocation for Sampling and Equal Proportions for Apportioning the U.S. House of Representatives."

University of Wisconsin, Madison, WI, February 13, 2013.
- Slud, Eric, "Small Area Confidence Bounds on Small Cell Proportions in Survey Populations."

Department of Statistics, Miami University, Oxford, OH, February 15, 2013.
- Wright, Tommy, "What Does the Census Bureau Do During the Other Nine Years?" (Panel, Interview and Discussion for "Stats and Stories," a radio program, as part of the International Year of Statistics Observance.)

School of Statistics, University of Minnesota, Minneapolis, MN. February 20, 2013.
- Erdman, Chandra, "The Other Nine Years: Research at the U.S. Census Bureau."

Department of Statistics, Florida State University, Tallahassee, FL. March 1, 2013.
- Monsell, Brian, "Research at the U.S. Census Bureau."

Southern Methodist University Statistics Masters Students Seminar, Dallas, TX, March 1, 2013.
- Mulry, Mary H., "Statistical Methods Used in Planning, Implementing, and Evaluating the 2010 Census Communications Campaign."

Departments of Statistics and Machine Learning, Carnegie-Mellon University, Pittsburgh, PA, March 6, 2013.
- Winkler, William E., "Record Linkage: Overview."

Department of Statistics, The Ohio State University, Columbus, OH, March 21, 2013.
- Wright, Tommy, "The Equivalence of Neyman Optimum Allocation for Sampling and Equal Proportions for Apportioning the U.S. House of Representatives."

Department of Economics, The Ohio State University, Columbus, OH, April 22, 2013.
- McElroy, Tucker, "Fitting Constrained Vector Autoregression Models."

2013 International Total Survey Error Workshop. Ames, IA, June 2-4 2013.
- Mulry, Mary H., Nichols, Elizabeth M., Hunter Childs, Jennifer, and Krishnamurty, Parvati, "Evaluating Recall Error in Survey Reports of Move Dates through a Comparison with Records in a Commercial Database." Invited.

Washington Statistical Society, Rockville, MD, June 4, 2013.
- Winkler, William E., "Background and Research in Methods for Adjusting Statistical Analyses for Record Linkage Error."

2013 Joint Conference by the International Chinese Statistical Association (ICSA) and the International Society for Biopharmaceutical Statistics (ISBS), Bethesda, MD, June 9-12, 2013.
- Klein, Martin, "Imputation for Nonmonotone Nonresponse in the Survey of Industrial Research and Development."

28th International Workshop on Statistical Modelling (IWSM), Statistical Modelling Society, Palermo, Italy, July 8-12, 2013.
- Steeg Morris, Darcy, "A Semiparametric Approach for Multivariate Longitudinal Count Data."

DC-AAPOR & WSS Summer Conference Preview/Review. Washington, DC, July 30-31, 2013.
- Hunter Childs, Jennifer, Mulry, Mary H., Nichols, Elizabeth, and Krishnamurty, Parvati. "Evaluating Recall Error in Survey Reports of Move Dates through a Comparison with Records in a Commercial Database." Invited.

Joint Statistical Meetings, American Statistical Association, Montreal, Québec, Canada, August 3-8, 2013.
- Taniecea Arceneaux and Burton Singer, "Link Prediction and the Effect of Missing Data on Social Networks."
- Gauri Datta, Brunero Liseo, and Serena Arima, "Small Area Estimation Method with Covariariates Subject to Measurement Error."

- Chandra Erdman and James Dahlhamer, "Evaluating Interviewer Observations in the National Health Interview Survey: Associations with Response Propensity."
- David Findley and Demetra Lytras, "The First-Order Seasonal Autoregressive Model as a Fundamental Model for Moving Seasonality and Model-Based Seasonal Adjustment."
- Carolina Franco and William Bell, "Applying Bivariate Binomial-Logit Normal Models for Small Area Estimation."
- Maria Garcia, Andreana Able, and Christopher Grieves, "Evaluation of Selective Editing for the Census Bureau Foreign Trade Data."
- Aaron Gilary, Jerry Maples, and Eric Slud, "Validity Testing for Coverage Properties of Small Area Models for Cell Proportions."
- Ryan Janicki and Eric Slud, "Effects of Missing Data on Modeling Enumeration Status in the U.S. Census."
- Patrick Joyce, Joseph Schafer, and Joshua Tokle, "Flexible Multivariate Imputation Modeling Based on Copulas and Dirichlet Processes."
- Martin Klein, "Noise Multiplication and Multiple Imputation as Alternatives to Top Coding for Statistical Disclosure Control: An Overview and Comparison."
- Joanna Lineback and Joseph Schafer, "Multivariate Linear Mixed-Effects Models for Missing Data Applied to a Business Survey."
- Jerry Maples and Matthew Brault, "Improving Small Area Estimates of Disability: Combining the American Community Survey with the Survey of Income and Program Participation."
- Tucker McElroy, "An Appraisal of Multivariate Seasonal Adjustment."
- Brian Monsell, "Comparing Automatic Modeling Procedures for TRAMO+ and X-13-ARIMA-SEATS."
- Darcy Steeg Morris and Yves Thibaudeau, "A Study of Data-Collection Rules Involving Real-Time Imputation for Adaptive Survey Design."
- Mary Mulry, Broderick Oliver, and Stephen Kaputa, "Setting M-Estimation Parameters for Detection and Treatment of Influential Values."
- Sharon O'Donnell and Yves Thibaudeau, "Extending Imputation Techniques to Fill Gaps in Longitudinal Surveys to Dynamic Imputation."
- Eric Slud, Reid Rottach, and Christopher Grieves, "Single-Stage Generalized Raking Weight Adjustments in the Current Population Survey."
- Yves Thibaudeau and Sharon O'Donnell, "Building a Complete History for Respondents in Longitudinal Surveys Through Imputation."
- Joshua Tokle, "Parameter Estimation for Record Linkage."
- Kevin Tolliver and Tucker McElroy, "Comparing Maximum Likelihood Estimation with Generalized Prediction Problem Mean-Square Minimization Estimation on Time Series Data."
- Thomas Trimbur and Tucker McElroy, "General and Consistent Signal Extraction for Nonstationary Time Series with Diverse Sampling Rules."
- Jerzy Wieczorek and Carolina Franco, "An Empirical Artificial Population and Sampling Design for Small-Area Model Evaluation."
- Marc Wildi and Tucker McElroy, "The Trilemma Between Accuracy, Timeliness, and Smoothness in Real-Time Forecasting and Signal Extraction."
- William Winkler, "Methods for Adjusting Statistical Analysis for Record Linkage Error."
- Tommy Wright, "A Visual Proof, a Test, and an Extension of a Simple Tool for Comparing Competing Estimates."
- William Yancey, "Methods of Computing Optimal Record-Linkage Parameters."
- Derek Young and Thomas Mathew, "Ratio Edits Based on Tolerance Intervals."

59th World Statistics Congress of the International Statistical Institute, Hong Kong, China, August 25-30, 2013.

- Monsell, Brian and Blakely, Chris, "X-13-ARIMA-SEATS and iMetrica."
- Wright, Tommy, Klein, Martin, and Wieczorek, Jerzy, "An Overview of Some Concepts for Potential Use in Ranking Populations Based on Sample Survey Data."

The First Asian ISI Satellite Meeting on Small Area Estimation (SAE), Bangkok, Thailand, September 1-4, 2013.

- Franco, Carolina and Bell, William R., "Applying Bivariate Binomial - Logit Normal Models For Small Area Estimation."

24th International Workshop on Household Survey Nonresponse, London, UK, September 4-6, 2013.

- Erdman, Chandra, "An Analysis of Adaptive Sampling Procedures in the National Health Interview Survey."

2013 NBER-NSF Time Series Conference, Washington, DC, September 26-27, 2013.

- McElroy, Tucker, "Non-Nested Model Comparisons For Time Series Via the Gaussian Likelihood Ratio Statistic."

5. CENTER FOR STATISTICAL RESEARCH AND METHODOLOGY SEMINAR SERIES

Bill Winkler, CSRM, U.S. Census Bureau, "Record Linkage Error Rate Estimation Course," October 4, 2012.

Jenna Fulton, (U.S. Census Bureau Dissertation Fellow) University of Maryland, College Park, "Respondent Consent to Use Administrative Data," October 24, 2012.

Julian Whiting, Australian Bureau of Statistics, "Developments in Household Survey Sample Design in Australia," November 6, 2012.

Zhiqiang Tan, Rutgers University, "Missing Data Problems and Survey Sampling," November 28, 2012.

Claire Monteleoni, George Washington University, "Clustering Algorithms for Streaming and Online Settings," November 29, 2012.

Anindya Roy, University of Maryland Baltimore County, "Predicting Ordered Parameters Under Measurement Error," December 6, 2012.

Bill O'Hare (ASA/NSF/Census Research Fellow) U.S. Census Bureau, "Data on the Undercount of Young Children in the U.S. Decennial Census," January 16, 2013.

Wen Zhou, University of Maryland, College Park, "Interval Estimation for Density Ratio Models with Out-of-Sample Fusion," January 29, 2013.

Jesse Frey, Villanova University, "Data-driven Non parametric Prediction Intervals," January 30, 2013.

James Livsey, Clemson University, "Small Integer Time Series and Discrete Renewal Processes," February 5, 2013.

Chris Blakely (U.S. Census Bureau Postdoctoral Researcher), CSRM, U.S. Census Bureau, "Dynamic Adaptive Signal Extraction," February 6, 2013.

Margo Anderson (ASA/NSF/Census Research Fellow) University of Wisconsin-Milwaukee, "Formulas, Ratios, Estimates, and Counts: The Historical Roots of Quantitative Public Policy in the U.S.," February 7, 2013.

Jiashen You, University of California, Los Angeles, "A Statistical Modeling Methodology for Analyzing Term Structure of Credit Risk and Its Dependency," February 12, 2013.

Partha Lahiri (Former ASA/NSF/Census Research Fellow) University of Maryland, College Park, "Recent Advances in Poverty Mapping Methodology," February 28, 2013.

Michael Higgins, University of California at Berkeley, "Optimal Blocking by Minimizing the Maximum Inter-block Dissimilarity," March 5, 2013.

Eric Slud, Department of Biostatistics at the University of Michigan, "Small Area Confidence Bounds on Small Cell Proportions in Survey Populations," March 14, 2013.

Kathryn Blackmond Laskey, George Mason University, "Bayesian Decision Theory and Adaptive Design," March 14, 2013.

Nikolas Mittag (U.S. Census Bureau Dissertation Fellow) University of Chicago, "A Method of Correcting for Misreporting Applied to the Food Stamp Program," March 28, 2013.

Roderick Little, University of Michigan & U.S. Census Bureau, "Partially-Missing at Random and Ignorability for Inferences about Subsets of Parameters with Missing Data," April 24, 2013.

Tommy Wright, CSRM, U.S. Census Bureau, "The Equivalence of Neyman Optimum Allocation for Sampling and Equal Proportions for Apportioning the U.S. House of Representatives," April 30, 2013.

Patrick Zimmerman (U.S. Census Bureau Dissertation Fellow), University of Minnesota, "Finite Population Sampling and Multiple Stratifications," May 21, 2013.

Paul Ohm, University of Colorado Law School/Federal Trade Commission, *SUMMER AT CENSUS,* "How Law and Policy Have Responded (and Should Yet Respond) to the Failure of Anonymization," May 30, 2013.

Rebecca Steorts, Carnegie Mellon University, *SUMMER AT CENSUS,* "Will the Real Steve Fienberg Please Stand Up: Getting to Know a Population From Multiple Incomplete Files," June 4, 2013.

Tucker McElroy, CSRM, U.S. Census Bureau, "A Multivariate Seasonal Adjustment of Regional Housing Starts," June 4, 2013.

Xiaofeng Shao, University of Illinois at Urbana-Champaign, *SUMMER AT CENSUS,* "Self-normalization," June 12, 2013.

Barry Graubard, National Cancer Institute, *SUMMER AT CENSUS,* "Conditional Logistic Regression with Survey Data," June 13, 2013.

Andrew Gelman, Columbia University, *SUMMER AT CENSUS,* "Choices in Statistical Graphics: My Stories," June 13, 2013.

Andrew Gelman, Columbia University, *SUMMER AT CENSUS,* "Weakly Informative Priors," June 14, 2013.

Omer Ozturk, The Ohio State University, *SUMMER AT CENSUS,* "Estimation of Population Mean and Total in a Finite Population Setting Using Multiple Auxiliary Variables," June 18, 2013.

Zhiqiang Tan, Rutgers University, *SUMMER AT CENSUS,* "Improved Shrinkage Estimation with Applications," June 20, 2013.

Glen Meeden, University of Minnesota, *SUMMER AT CENSUS,* "Objective Stepwise Bayes Weights in Survey Sampling," June 25, 2013.

Yong Ming Jeffrey Woo (U.S. Census Bureau Dissertation Fellow), The Pennsylvania State University, "Optimization and Statistical Estimation for the Post Randomization Method," June 26, 2013.

Phil Kott, RTI International, *SUMMER AT CENSUS,* "Calibration Weighting with SUDAAN 11," July 8, 2013.

James P. Ziliak, University of Kentucky, *SUMMER AT CENSUS,* "Multigenerational Families and Food Insecurity," July 9, 2013.

Samantha Cockings, University of Southampton, *SUMMER AT CENSUS,* "Creating and Maintaining Statistical Geographies Using Automated Zone Design Techniques," July 16, 2013.

Yan Lu, University of New Mexico, *SUMMER AT CENSUS,* "Regression Estimation in Dual Frame Surveys," July 16, 2013.

John Iceland, Pennsylvania State University, *SUMMER AT CENSUS,* "White Residential Segregation in U.S. Metropolitan Areas: Conceptual Issues, Patterns, and Trends from the U.S. Census, 1980 to 2010," July 17, 2013.

Carolyn Liebler, University of Minnesota, *SUMMER AT CENSUS,* "American Indians without Tribes in the 21st Century," July 22, 2013.

Nathan Yau, FlowingData.com, *SUMMER AT CENSUS,* "Visualizing Data for an Audience," July 24, 2013.

Matthew Shapiro and Margaret Levenstein, University of Michigan, *SUMMER AT CENSUS,* "CenHRS: Integrating HRS with Census Employer Data to Enhance Understanding of the Employment Prospects of Older Americans," July 25, 2013.

Frauke Kreuter, University of Maryland, College Park, *SUMMER AT CENSUS,* "Experiments Testing the Use of Paradata in Official Statistics Production," July 30, 2013.

Gordon B. Dahl, University of California, San Diego, *SUMMER AT CENSUS,* "Family Welfare Cultures," July 30, 2013.

Sanjay Chaudhuri, National University of Singapore, *SUMMER AT CENSUS,* "A Conditional Empirical Likelihood Approach to Combine Sampling Design and Population Level Information," August 1, 2013.

Ann Morning, New York University, *SUMMER AT CENSUS,* "Racial and Ethnic Classification in Global Perspective: Understanding the Sociology of Racial Conceptualization for the 21st Century Around the World," August 6, 2013.

Marc Wildi, Zurich University of Applied Sciences, *SUMMER AT CENSUS,* "An Introduction to the Direct Filter Approach and Current Research," August 13, 2013.

Barry Hirsch, Georgia State University, *SUMMER AT CENSUS,* "The Implications of Non-response in Census Surveys: Evidence from the CPS and ACS," August 14, 2013.

Ashwin Machanavajjhala, Duke University, *SUMMER AT CENSUS,* "Tuning Privacy-Utility Tradeoffs in Statistical Databases Using Policies," August 15, 2013.

Claire Jantz, Shippensburg University, *SUMMER AT CENSUS,* "Estimating the Completeness of TIGER Road Data Using the SLEUTH Urban Growth Forecasting Model," August 15, 2013.

Aliya Saperstein, Stanford University, *SUMMER AT CENSUS,* "The Past and Present Significance of Racial Mobility: Revisiting Homer Plessy and the Mulatto Escape Hatch," August 19, 2013.

Amy Griffith, University of New South Wales, Canberra, *SUMMER AT CENSUS,* "A Context-of-use Study to Inform the Design and Testing of Visualizations of Uncertainty for Supporting Planners Using ACS Estimates," August 19, 2013.

Vivekananda Roy, Iowa State University, *SUMMER AT CENSUS,* "Monte Carlo Methods for Improper Target Distributions," August 20, 2013.

Daniel Almirall, University of Michigan, *SUMMER AT CENSUS,* "Workshop on Adaptive Treatment Strategies and Sequential Multiple Assignment Randomized Trial (SMART) Designs," September 24, 2013.

Tucker McElroy, CSRM, U.S. Census Bureau, "Non-nested Model Comparisons for Time Series Via the Gaussian Likelihood Ratio Statistic," September 25, 2013.

Cecile Schutt, Statistics Netherlands, "The Impact of New Digital Data Sources on Governmental Information Provision and on National Statistical Organizations," September 30, 2013.

6. PERSONNEL ITEMS

6.1 HONORS/AWARDS/SPECIAL RECOGNITION

6.2 SIGNIFICANT SERVICE TO PROFESSION

Taniecea Arceneaux
- Refereed a paper for *Social Science Computer Review*.

Chandra Erdman
- Refereed a paper for *Journal of Official Statistics.*

Carolina Franco
- Refereed a paper for *The American Statistician* and *Sankhya Series B.*

Maria Garcia
- Refereed a paper for *Journal of Official Statistics.*
- Session Organizer and Discussant, "New and Emerging Methods in Editing and Imputation," United Nations/Economic Commission for Europe (UN/ECE) Work Session on Statistical Data Editing.

Ryan Janicki
- Refereed papers for *Survey Methodology* and *Journal of the Royal Statistical Society, Series B.*

Patrick Joyce
- Refereed a paper for *Journal of Quantitative Analysis in Sports.*

Martin Klein
- Refereed papers for *Current Bioinformatics, Sankhya Series B, Journal of Privacy and Confidentiality*, and *Journal of the Royal Statistical Society, Series B.*
- Member, Ph.D. Dissertation in Statistics Committee, University of Maryland, Baltimore County.
- Chair, Invited Paper Session – "Rankings, Use of Ranks, and Survey Sampling," 59th World Statistics Congress/International Statistics Institute (ISI), Hong Kong (2013).

Ben Klemens
- Refereed papers for *Journal of Official Statistics* and *Methodology*.

Jerry Maples
- Refereed papers for *Journal of Survey Statistics and Methodology, Computational Statistics and Data Analysis*, and *Journal of the American Statistical Association.*

Tucker McElroy
- Refereed papers for *Computational Statistics and Data Analysis*, *Journal of Nonparametric Statistics, Electronic Journal of Statistics, Journal of Multivariate Analysis, Annals of Statistics, Journal for the International Association for Official Statistics, Journal of Official Statistics*, and *Journal of Business Cycle Measurement and Analysis.*
- Reviewer, grant proposal for the Japan Society for the Promotion of Science and the National Security Agency.
- Reviewer, book review for *Journal of the American Statistical Association*, and a Springer-Verlag monograph.
- Organizer, two Topic-Contributed Sessions, Joint Statistical Meetings.
- Chair, Topic-Contributed Session, Joint Statistical Meetings.

Mary H. Mulry
- Vice President, American Statistical Association.
- Associate Editor, *Journal of Official Statistics*.

- Participant, NAS Experts Meeting to review NASS methodology.
- Member, Program Committee, International Conference on Methods for Surveying and Enumerating Hard-to-Reach Populations, New Orleans, LA., October 31 – November 3, 2012.

Osbert Pang
- Refereed a paper for *Journal of Official Statistics.*

Darcy Steeg Morris
- Refereed a paper for the *Journal of Official Statistics.*
- Poster Judge, UMBC Probability and Statistics Day.

Eric Slud
- Associate Editor, *Journal of the Royal Statistical Society, Series B.*
- Associate Editor, *Lifetime Data Analysis.*
- Associate Editor, *Journal of Survey Statistics and Methodology.*
- Associate Editor, *Biometrika.*
- Refereed papers for *Survey Methodology*, *Journal of Survey Statistics and Methodology*, *The Open Statistics and Probability Journal*, *Haematology*, *Journal of the Royal Statistical Society Series C*, and *Annals of Applied Statistics.*
- Member, Hansen Lecture Committee, Washington Statistical Society.

Josh Tokle
- Refereed a paper for *Biometrika.*

Jerzy Wieczorek
- Refereed a paper for *Journal of Official Statistics.*

William Winkler
- Associate Editor, *Journal of Privacy and Confidentiality.*
- Associate Editor, *Transactions on Data Privacy.*
- Member group under the auspices of the Royal Academy advising the UK government on "Data Linkage and Anonymisation" in the social sciences.
- Member, Ph.D. Dissertation in Statistics Committee, Carnegie Mellon University.
- Program Committee Member, Statistical Data Protection 2014.
- Refereed papers for *Annals of Applied Probability* and *Information Systems and International Statistical Review*.

Tommy Wright
- Associate Editor, *The American Statistician.*
- Member, Advisory Board, Department of Mathematics and Statistics, Georgetown University.
- Member, Workgroup on Master's Degrees, American Statistical Association.
- Ph.D. Tenure Review of Statistics Faculty Member, Department of Mathematics and Statistics, University of New Mexico.
- Member, Ph.D. Dissertation Advisory Committee, University of Maryland, College Park.
- Refereed paper for *Computational Statistics and Data Analysis Journal.*
- Organizer, Invited Paper Session – "Rankings, Use of Ranks, and Survey Sampling," 59th World Statistics Congress/International Statistics Institute (ISI), Hong Kong (2013).
- Participant, INGenIOuS Workshop (on The Nation's Mathematical Sciences Workforce), National Science Foundation, Mathematical Association of America, American Statistical Association, American Mathematical Society, and Society for Industrial and Applied Mathematics.
- Member, Cochran-Hansen Prize Committee, International Association of Survey Statisticians.

Derek Young

- Refereed papers for the *Journal of Business and Economic Statistics*, *Journal of Hydrology*, *Journal of Computational and Graphical Statistics*, *Electronic Journal of Statistics*, *Journal of Educational and Behavioral Statistics*, and *Far East Journal of Applied Mathematics*.
- Poster Judge, UMBC Probability and Statistics Day.

6.3 PERSONNEL NOTES

Anindya Roy (member of the statistics faculty at the University of Maryland-Baltimore County) accepted a Schedule A appointment in our Time Series Research Group.

Ann Dimler was reassigned to the Center for Survey Measurement.

David Vernet (senior in mathematics at the University of Maryland, College Park) joined our center as an intern.

Isaac Dompreh was reassigned from the Economic Directorate to our Center and joined our Statistical Computing Area.

Jiashen You joined our Small Area Estimation Research Group.

James Livsey joined our Time Series Research Group.

Jerzy Wieczorek began work towards a Ph.D. in statistics at Carnegie Mellon University.

Wayne Pat Hunley (senior following a dual degree program in mathematics (statistics track) and economics at the University of Maryland, College Park) joined our center as an intern.

APPENDIX A **Center for Statistical Research and Methodology FY 2013**
Program Sponsored Projects/Subprojects With Substantial Activity and Progress and Sponsor Feedback
(Basis for PERFORMANCE MEASURES)

Project #	Project/Subproject Sponsor(s)	CSRM Contact	Sponsor Contact
	DECENNIAL		
5610302 /	Statistical Design and Estimation		
6410301 /	1. *Decennial Record Linkage*	William Winkler	Susanne L. Johnson
6410307 /	2. *Coverage Measurement Research*	Jerry Maples	Pat Cantwell
6510301	3. *Accuracy of Coverage Measurement*	Mary Mulry	Pat Cantwell
	4. *Record Linkage Error-Rate Estimation Methods*	William Winkler	Tom Mule
	5. *Master Address File (MAF) Error Model and Quality Assessment*	Derek Young	Robin Pennington
	6. *Supplementing and Supporting Non-Response with Administrative Records*	Michael Ikeda	Asaph Young Chun
	7. *Identifying "Good" Administrative Records for 2020 Census NRFU Curtailment Targeting*	Yves Thibaudeau	Tom Mule
	Coding, Editing, and Imputation Study		
	8. *Software Development (Tea)*	Ben Klemens	Pat Cantwell
	9. *Software Analysis and Evaluation*	Rolando Rodriguez	Andrew Keller
6710304	Privacy and Confidentiality Study		
	10. *Privacy and Confidentiality for the 2020 Census*	Martin Klein	Jennifer Hunter Childs
6810305	Matching Process Improvement		
	11. *2020 Unduplication Research*	Michael Ikeda	Susanne L. Johnson
5385260	American Community Survey (ACS)		
	12. *ACS Applications for Time Series Methods*	Tucker McElroy	Mark Asiala
	13. *Data Analysis of ACS CATI-CAPI Contact History*	Eric Slud	Deborah Griffin
	DEMOGRAPHIC		
TBA	Demographic Statistical Methods Division Special Projects		
	14. *Tobacco Use Supplement (NCI) Small Domain Models*	Aaron Gilary	Benmei Liu
	15. *Special Project on Weighting and Estimation*	Eric Slud	Yang Cheng
0906/1442	Demographic Surveys Division Special Projects		
	16. *Data Integration*	Ned Porter	Marie Pees
7523013 /	National Crime Victimization Survey		
7523014	17. *Analyzing the Effects of Sample Reinstatement, Refresher Training Experiment, and Process Monitoring and Fitness for Use*	Joe Schafer	Bill Samples
TBA	Population Division Projects		
	18. *Population Projections*	Tucker McElroy	Jennifer Ortman
1465444	Survey of Income and Program Participation (SIPP) Improvements Research		
	19. *Model-Based Imputation for the Demographic Directorate*	Maria Garcia	David Johnson
7165013	Social, Economic, and Housing Statistics Division Small Area Estimation Projects		
	20. *Research for Small Area Income and Poverty Estimates (SAIPE)*	Jerry Maples	Wes Basel
	21. *Small Area Health Insurance Estimates (SAHIE)*	Ryan Janicki	Don Lurey
0189115	Improving Poverty Measures/IOE		
	22. *Tract Level Estimates of Poverty from Multi-year ACS Data*	Jerry Maples	Wes Basel
	23. *Small Area Estimates of Disability*	Jerry Maples	Wes Basel
	ECONOMIC		
2320354	24. *Editing Methods Development (Investigation of Selective Editing Procedures for Foreign Trade Programs)*	Maria Garcia	Ryan Fescina
2320352	Time Series Research		
	25. *Seasonal Adjustment Support*	Brian Monsell	Kathleen McDonald-Johnson
	26. *Seasonal Adjustment Software Development and Evaluation*	Brian Monsell	Kathleen McDonald-Johnson
	27. *Research on Seasonal Time Series - Modeling and Adjustment Issues*	Tucker McElroy	Kathleen McDonald-Johnson
	28. *Identifying Edits in the Quarterly Financial Report*	Tucker McElroy	Kathleen McDonald-Johnson
	29. *Supporting Documentation/Software: X-12-ARIMA and X-13A-S*.	Brian Monsell	Kathleen McDonald-Johnson
TBA	30. *Statistical Consulting for LEHD Audit*	Darcy Steeg Morris	Andrea Chamberlain

APPENDIX B

FY 2013 PROJECT PERFORMANCE MEASUREMENT QUESTIONNAIRE

CENTER FOR STATISTICAL RESEARCH AND METHODOLOGY

Dear

In a continuing effort to obtain and document feedback from program area sponsors of our projects or subprojects, the Center for Statistical Research and Methodology will attempt for the fifteenth year to provide *seven measures of performance*, this time for the fiscal year 2013. For FY 2013, the *measures of performance* for our center are:

- *Measure 1. Overall, Work Met Expectations:* Percent of FY 2013 Program Sponsored Projects/Subprojects where sponsors reported that work met their expectations.
- *Measure 2. Established Major Deadlines Met:* Percent of FY 2013 Program Sponsored Projects/Subprojects where sponsors reported that all established major deadlines were met.
- *Measure 3a. At Least One Improved Method, Developed Technique, Solution, or New Insight:* Percent of FY 2013 Program Sponsored Projects/Subprojects reporting at least one improved method, developed technique, solution, or new insight.
- *Measure 3b. Plans for Implementation*: Of the FY 2013 Program Sponsored Projects/Subprojects reporting at least one improved method, developed technique, solution, or new insight, the percent with plans for implementation.
- *Measure 4. Predict Cost Efficiencies:* Number of FY 2013 Program Sponsored Projects/Subprojects reporting at least one "predicted cost efficiency."
- *Measure 5. Journal Articles, Publications:* Number of journal articles (peer review) and publications documenting research that appeared or were accepted in FY 2013.
- *Measure 6. Proceedings Publications:* Number of proceedings publications documenting research that appeared in FY 2013.

These measures will be based on response to the five questions on this form from our sponsors as well as from members of our center and will be used to help improve our efforts.

To construct these seven measures for our center, we will combine the information for all of our program area sponsored projects or subprojects obtained during November 26 thru December 7 using this questionnaire. Your feedback is requested for:

Project Number and Name: _____
Sponsoring Division(s): _____

After all information has been provided, the CSRM Contact _____ will ensure that the signatures are obtained in the order indicated on the last page of this questionnaire.

We very much appreciate your assistance in this undertaking.

_____

Tommy Wright Date
Chief, Center for Statistical Research and Methodology

Brief Project Description ***(CSRM Contact will provide from Division's Quarterly Report):***

Brief Description of Results/Products from FY 2013 ***(CSRM Contact will provide)****:*

(over)

TIMELINESS:
Established Major Deadlines/Schedules Met

1(a). Were all established major deadlines associated with this project or subproject met? **(Sponsor Contact)**

□ Yes □ No □ No Established Major Deadlines

1(b). If the response to 1(a) is No, please suggest how future schedules can be better maintained for this project or subproject. **(Sponsor Contact)**

QUALITY & PRODUCTIVITY/RELEVANCY:
Improved Methods / Developed Techniques / Solutions / New Insights

2. Listed below are at most 2 of the top improved methods, developed techniques, solutions, or new insights offered or applied on this project or subproject in FY 2013 where an CSRM staff member was a significant contributor. Review "a" and "b" below **(provided by CSRM Contact)** and make any additions or deletions as necessary. For each, please indicate whether or not there are plans for implementation. If there are no plans for implementation, please comment.

□ No improved methods/techniques/solutions/new insights developed or applied.

□ Yes as listed below. (See a and b.)

Plans for Implementation?

a. _____ Yes □ No □

b. _____ Yes □ No □

Comments (Sponsor Contact):

COST:
Predict Cost Efficiencies

3. Listed **(provided by CSRM Contact)** below are at most two research results or products produced for this project or subproject in FY 2013 that predict cost efficiencies. Review the list, and make any additions or deletions as necessary. Add any comments.

□ No cost efficiencies predicted.
□ Yes as listed below. (See a and b.)

a.

b.

Comments (Sponsor Contact):

OVERALL:
Expectations Met/Improving Future Communications

4. Overall, work on this project or subproject by CSRM staff during FY 2013 met expectations. **(Sponsor Contact)**

□ Strongly Agree
□ Agree
□ Disagree
□ Strongly Disagree

5. Please provide suggestions for future improved communications or any area needing attention on this project or subproject. **(Sponsor Contact)**

(CSRM Contact will coordinate first two signatures as noted and pass to CSRM Chief.)

First_____
Sponsor Contact Signature Date

Second_____
CSRM Contact Signature

(CSRM Chief will coordinate last two signatures as noted.)

Third_____
Sponsor Division Chief Signature Date

Fourth_____
CSRM Center Chief Signature Date

Center for Statistical Research and Methodology

Research & Methodology Directorate

STATISTICAL COMPUTING AREA
Joe Schafer
Alisha Armas
Isaac Dompreh

Machine Learning & Computational Statistics Research
Bill Winkler
Joshua Tokle
William Yancey

Statistical Computing Applications & Data Visualization Research
Ben Klemens
Tom Petkunas
Ned Porter
Rolando Rodriguez

Missing Data Methods Research
Yves Thibaudeau
Chandra Erdman
Douglas Galagate (S)
Maria Garcia
Martin Klein
Darcy Morris
Jun Shao (U. of WI)

Research Computing Systems
Chad Russell
VACANT

MATHEMATICAL STATISTICS AREA
Eric Slud
Erica Magruder (HRD)

Sampling & Estimation Research
Eric Slud (Acting)
Carolina Franco
Mike Ikeda
Patrick Joyce
Mary Mulry
VACANT

Small Area Estimation Research
Jerry Maples
Gauri Datta (U. of GA)
Aaron Gilary
Ryan Janicki
Jiashen You

Time Series Research
Brian Monsell
Chris Blakely (Postdoc)
David Findley
VACANT
Tucker McElroy
James Livsey
Osbert Pang
Aninyda Roy (UMBC)

Experimentation, Simulation, & Modeling Research
Tommy Wright (Acting)
Thomas Mathew (UMBC)
Derrick Simmons (S)
Derek Young

Tommy Wright, Chief
Kelly Taylor
Bill O'Hare (F)
Michael Leibert
Michael Hawkins
Patrick Hunley (S)
Sarah Wilson

(F) ASA/NSF/Census Research Fellow
(S) Student

September 30, 2013