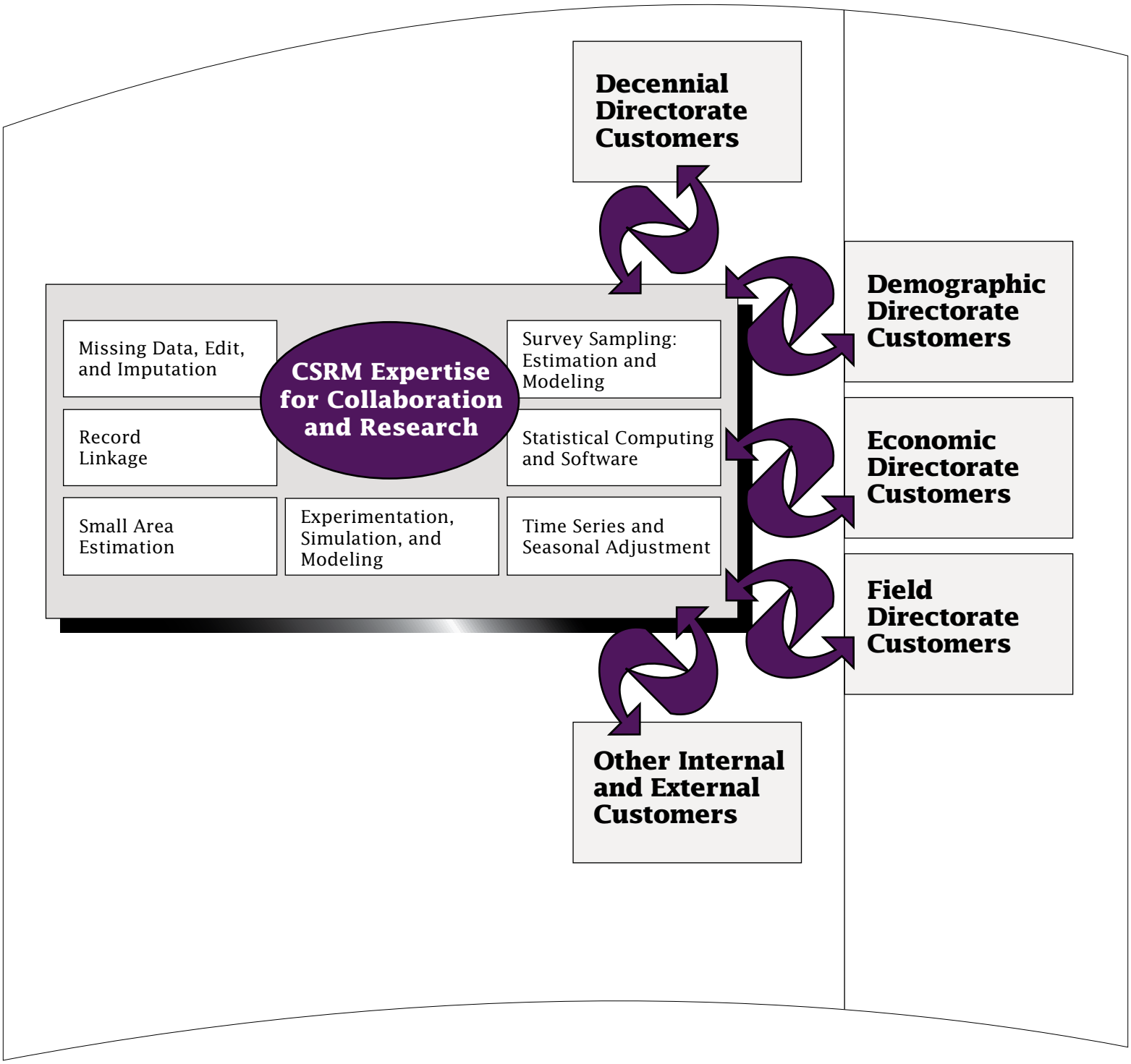
Annual Report *of the* Center for Statistical Research and Methodology

Research and Methodology Directorate

Fiscal Year 2014



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.

U.S. Census Bureau
Center for Statistical Research and Methodology
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We help the Census Bureau improve its processes and products. For fiscal year 2014, 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 2014 follow, and more details are provided within subsequent pages of this report:

- *Missing Data, Edit, and Imputation*: (1) researched classification techniques for determining sufficiently reliable administrative records for purposes of Census enumeration; (2) investigated alternative classification techniques such as classification trees and random forests; (3) researched topics such as multiple imputation hot deck via Approximate Bayesian Bootstrap, sequential regression multiple imputation (SRMI), and properties of the Fraction of Missing Information (FMI); and (4) provided data-preparation and response propensity modeling code for use in data from the 2013 Census Test to explore new methods for data collection in the 2020 Census nonresponse follow-up operation.

- *Record Linkage:* (1) produced some updates/revisions to the error-rate estimation software.

- *Small Area Estimation*: (1) combined data from the American Community Survey (ACS) and Survey of Income and Program Participation (SIPP) to model estimates of disability at the county level; (2) conducted a comprehensive simulation study to evaluate which model framework produces better confidence intervals for small rates (near 0%) when the sample size is small under a variety of data generation mechanisms; and (3) created an artificial population from 5-year ACS microdata to assist in Small Area model evaluations which makes estimates at the tract level.

- *Survey Sampling-Estimation and Modeling*: (1) analyzed 2012 ACS CAPI data to inform policy changes in curtailing CAPI contact attempts to minimize respondent burden with minimal loss of completed interviews; (2) refined methodology for implementing an M-estimation algorithm for detecting and treating influential values in economic surveys—with minimal false detections—that is widely applicable in the presence of seasonal effects; (3) designed and implemented a multi-factor simulation to assess the performance of several competing types of confidence intervals for proportions in complex surveys such as ACS; and (4) generalized an exact method of optimal sample allocation, demonstrated that it is more efficient than Neyman Allocation, and applied the generalized method to data from the service Annual Survey

- *Statistical Computing and Software*: (1) revised and enhanced *X-13ARIMA-SEATS* to include new seasonality diagnostics and improvements in the accessible HTML output; (2) developed milestone of *Apophenia* software for generalized statistical modeling; (3) developed new methods for distribution of *Tea*; and (4) improved SAHIE small area estimation software.

- *Time Series and Seasonal Adjustment*: (1) revised several times the *X-13ARIMA-SEATS* and updated the version of *SEATS* incorporated into the software and developed enhancements that include new seasonality diagnostics, and improvements in the accessible HTML output; (2) wrote multivariate seasonal adjustment methodology, algorithms, and software and tested them on retail and construction series; and (3) conducted methodological research into the Visual Significance criterion for spectral peak detection, with derivations of asymptotic distributions being obtained, as well as the linkage between correlation behavior and spectral shape.

- *Experimentation, Simulation, and Modeling:* (1) studied further properties of zero-inflated models as an appropriate strategy for modeling the coverage errors of the Master Address File (MAF).

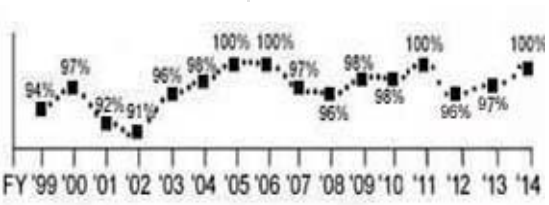
- *SUMMER AT CENSUS:* Sponsored, with divisions around the Census Bureau, scholarly, short-term visits by 31 researchers/leaders who collaborated extensively with us and presented seminars on their research. For a list of the 2014 *SUMMER AT CENSUS* scholars, see *http://www.census.gov/research/summer_at_census/*

How Did We[1] Do...

For the 16th year, we received feedback from our sponsors. Near the end of fiscal year 2014, our efforts on 33 of our program (Decennial, Demographic, Economic, Administration, 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 33 questionnaires were obtained with the following results (The graph associated with each measure shows the performance measure over the last 16 fiscal years):

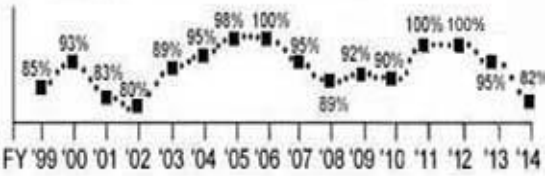
Measure 1. Overall, Work Met Expectations

Percent of FY2014 Program Sponsored Projects/Subprojects where sponsors reported that overall work met their expectations (agree or strongly agree) (33 out of 33) …….…….... 100%



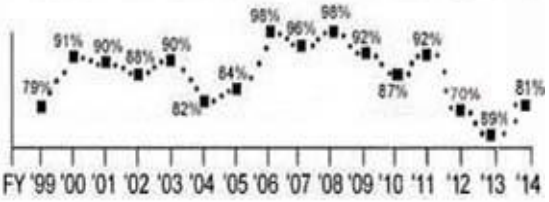
Measure 2. Established Major Deadlines Met

Percent of FY2014 Program Sponsored Projects/Subprojects where sponsors reported that all established major deadlines were met (18 out of 22 responses) ……....…….... 82%



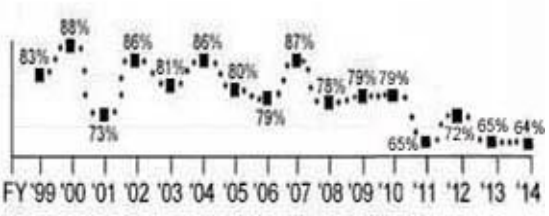
Measure 3a. At Least One Improved Method, Developed Technique , Solution, or New Insight

Percent of FY2014 Program Sponsored Projects/Subprojects reporting at least one improved method, developed technique, solution, or new insight (25 out of 31 responses) …… 81%



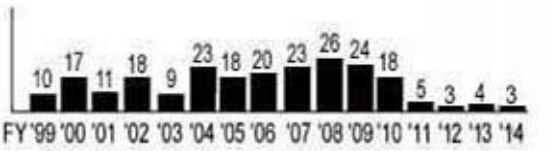
Measure 3b. Plans for Implementation

Of these FY2014 Program Sponsored Projects/Subprojects reporting at least one improved method, technique developed, solution, or new insight, the percent with plans for implementation (16 out of 25 responses) …….. 64%



Measure 4. Predict Cost Efficiencies

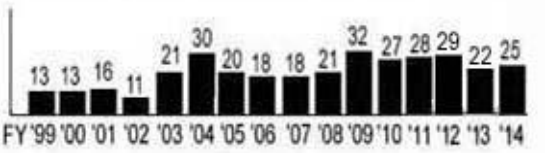
Number of FY2014 Program Sponsored Projects/Subprojects reporting at least one "predicted cost efficiency" ……..…… 3



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

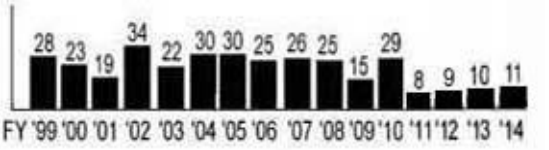
Measure 5. Journal Articles, Publications

Number of peer reviewed journal publications documenting research that appeared (16) or were accepted (9) in FY2014 ……... 25



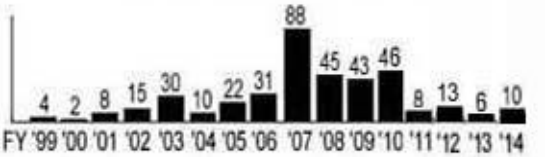
Measure 6. Proceedings, Publications

Number of proceedings publications documenting research that appeared in FY2014 ……. 11



Measure 7. Center Research Reports/Studies, Publications

Number of center research reports/studies publications documenting research that appeared in FY2014 …….. 10



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.

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1. COLLABORATION

1.1 REDESIGN/IMPROVEMENT PERSON FOLLOW-UP (Decennial Project 6410402)

1.2 ADMINISTRATIVE RECORDS MODELING (Decennial Project 6810407)

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: The details of this project are described in the project Record Linkage Error Rates that is being applied to Decennial Statistical Studies Division (DSSD) and Center for Administrative Records Research and Applications (CARRA) data.

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

B. 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: During FY 2014, staff expanded the large-scale simulation study to test coverage under different small-area models. Staff implemented a factorial design to examine the effect of small area analysis model, data generation model, and the spread of sampling error variances between the small areas. Although the data generation models are different functional forms (Beta-Binomial, Arcsin Square Root Fay Herriot and Generalized Linear Mixed Model), the parameters were chosen so that the population mean and variance were similar. Staff drafted a report titled "Validating Properties of Three Small Area Models of Small Cell Proportions" by Gilary, Maples and Slud which will be finalized in Q1 of FY 2015.

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

C. Using 2010 Census Coverage Measurement Data to Compare Non-Response Follow-up Proxy Responses with Administrative Records

Description: Research in preparation for the 2020 Census Non-Response Follow-up (NRFU) investigates employing different contact strategies combined with the use administrative record (AR) files in different ways in order to reduce the cost of the operation while maintaining data quality. Regardless of the contact strategy, the question arises as to whether the proxy responses are more accurate than ARs available for the NRFU housing units (HUs). This study seeks to answer this question by comparing the quality of the 2010 Census NRFU addresses with proxy responses and the administrative records data for the same timeframe for those HUs using the 2010 Census Coverage Measurement (CCM) sample. The assessment of the quality of the proxy responses and the records in administrative records takes advantage of the extensive fieldwork, processing, and clerical matching conducted for the CCM. When a person enumerated by a 2010 Census NRFU proxy response in a housing unit in the CCM sample is found in the administrative records file at the same address, the CCM information for the proxy response indicates whether the person's census enumeration at the address was correct. The CCM information also assesses the administrative records information for the housing units in the CCM sample. This approach identifies Census Day residents in the CCM sample not present at their addresses in the administrative records file.

Highlights: During FY 2014, staff collaborated with staff in the Decennial Statistical Studies Division on the development of a methodology for using the results of the 2010 CCM to compare the quality of 2010 Census NRFU responses in the CCM sample with Internal Revenue Services and Medicare records from all of 2010 available for the housing unit. Staff prepared a study plan that is currently under review. Preliminary results are available, and work to complete the analyses is underway.

Staff: Mary Mulry (x31759)

D. 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 June 2014, staff received two pairs of Center for Administrative Records Research and Applications (CARRA) administrative files for testing and enhancing the methods of Belin and Rubin (*JASA* 1995) and Winkler (2002, 2006). Winkler had previously documented and distributed the current versions of the software that is now running on one of the CARRA machines. Staff moved some additional software from Research2 to the CARRA machine. Staff is in the process of better understanding some of the data in the

files. We are in the process of getting additional clarification of the files that CARRA provided.

One staff person created a version of *BigMatch* that produces the "counter files" needed as input in the EM software, which yields optimal record linkage parameters in some situations and that we are hoping to extend with some of the research.

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

E. Supplementing and Supporting Non-Response with Administrative Records

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

Highlights: During FY 2014, the Cost/Quality Strategy Team, which had coordinated this project, suspended operations. Staff joined the Administrative Records Modeling team. This team will be coordinating future work by staff on this project. Staff familiarized themselves with relevant data files and reviewed draft documents prepared by other team members. Staff also distributed draft documentation of some preliminary research done for the Cost/Quality Strategy team to a subgroup of the Administrative Records Modeling team. Staff prepared and distributed a study proposal for using CCM results to compare the accuracy of administrative records with the accuracy of proxy 2010 NRFU responses. Staff used a NRFU data file to produce cross tabulations and correlations of potential covariates with outcome variables related to NRFU difficulty (for occupied NRFU housing units (HUs)). None of the covariates stood out as having a particularly strong association with any of the outcome variables, although some covariates appeared to show some association. Staff prepared a draft overview of these preliminary results. Staff also reviewed and provided comments on a study proposal for a propensity model research project. The project would be a continuation of research conducted by the former Cost/Quality Strategy Team. Staff used the NRFU data file and a second file containing only NRFU IDs from Maricopa County, Arizona to produce cross tabulations and correlations of potential covariates with household size for occupied NRFU HUs. This preliminary analysis reconfirms that the number of IRS 1040 persons should be a useful covariate, although IRS data is missing for nearly half of the occupied NRFU HU IDs.

Staff: Michael Ikeda (x31756), Mary Mulry

F. 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 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 the beginning of FY 2014, staff continued to explore classification tools for classifying administrative records according to their usefulness for the non-response follow-up operations (NRFU). Staff attended a short course on decision trees and random forests. Staff then researched the predictive power of logistic regression compared to classification trees and random forests as tools to make decisions regarding the use of administrative records for NRFU. Staff gave an internal presentation of the results, circulated a draft paper internally, presented this work at the Joint Statistical Meetings (JSM), and completed a *JSM Proceedings* paper titled "A Comparison of Methodologies for Classification of Administrative Records Quality for Census Enumeration." Staff also worked on applying classification tree and random forest methods to predict occupancy status for NRFU housing units from various administrative record sources. Staff initiated involvement in determining the administrative record enumeration strategy for the 2015 Census test.

Staff: Darcy Steeg Morris (x33989), Yves Thibaudeau

G. Evaluation of Response Error Using Administrative Records

Description: Censuses and their evaluations ask respondents to recall where they lived on Census Day, April 1. Some interviews for evaluations take place up to eleven months after this date. Respondents are asked when they moved to their current address, and the assumption has been that respondents who move around April 1 are able to give correct answers. Error in recalling a move or a move date may cause respondents to be enumerated at the wrong location in the census. This study investigates recall error in reports of moves and move dates in censuses and surveys using data from survey files linked to administrative records.

Highlights: During FY 2014, staff continued to collaborate with staff in the Center for Survey

Measurement (CSM) on analyses of recall error for reports of moves and move dates in surveys using data from survey files linked to administrative records. Staff has pursued two studies. One uses data prepared for the "Memory Recall of Migration Dates in the National Longitudinal Survey of Youth" developed under a contract with the National Opinion Research Center (NORC). The other study uses data from the Recall Bias Study, which was part of the 2010 Census Evaluation and Experiments Program. Draft papers containing results on recall error have undergone review, and revisions are underway.

Staff: Mary Mulry (x31759)

1.3 MAF ERROR MODEL (Decennial Project 6310401)

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

Description: The 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: During FY 2014, staff refined the zero-inflated models used to characterize MAF errors. Proposed models based on zero-inflated Poisson and zero-inflated negative binomial distributions were obtained using various goodness-of-fit and model comparison measures. They performed well for identifying areas having large numbers of adds/deletes during the 2010 Address Canvassing operation. The methodology was vetted with the Executive Steering Committee and presented at the second 2020 Census Program Management Review of FY 2014. Then, the modeling database was recreated due to a geocoding error that was identified in the original database. Using the new database, models similar to those obtained previously were found to have diminished performance in terms of prediction and informing canvassing decisions. Subsequent efforts have focused on improving the regression models, including the addition of economic variables and administrative records.

Staff: Andrew Raim (x37894), Derek Young, Nancy Johnson (DSSD)

B. Census Enterprise Microsimulator

Description: The Census Enterprise Model (CEM) is a microsimulation tool developed by The MITRE Corporation jointly with the Census Bureau. Given a list of households, a decision tree describing possible census outcomes, and a set of probabilities corresponding to those outcomes, the CEM provides simulated realizations of a census. These realizations can be used to compare cost and quality among various competing strategies being considered for the 2020 Decennial Census.

Highlights: During FY 2014, staff attended a series of meetings in which MITRE led tutorials on use of the software. After handoff of the software, efforts have focused on implementing a full-scale end-to-end study with the CEM. This has involved integration of the zero-inflated models for MAF coverage error, to be used in data generation for address canvassing.

Staff: Andrew Raim (x37894), Deborah Fenstermaker (DSSD), David Brown (CES)

1.4 CODING, EDITING, AND IMPUTATION STUDY (Decennial Project 6510401)

A. Software Development (*Tea*)

Description: Here we report applications of *Tea* software to the coming 2020 Census. *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: During FY 2014, staff began rewriting the edit specification for the American Community Survey (ACS) using the much more compact grammar used by *Tea*. Staff made some improvements to the underlying code base to accommodate the complexity of ACS edits, notably in better handling of the large number of deterministic changes to the data.

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

B. 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: During FY 2014, staff tested hierarchical log-linear models as a means for characteristic imputation for the 2020 Decennial Census. Staff paid particular attention to imputation of ethnicity, positing various mechanisms for missing data, including data missing at random given administrative data, and data missing not at random. Future research will expand to imputation for the other census items, and will use census test data to develop a better understanding of missingness patterns.

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

1.5 PRIVACY AND CONFIDENTIALITY STUDY (Decennial Project 6810404)

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: Work on this project was suspended during FY 2014.

Staff: Martin Klein (x37856)

1.6 MATCHING PROCESS IMPROVEMENT (Decennial Project 6810405)

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: During FY 2014, the Matching Process Improvement Team (which coordinates this project) went on hiatus. Staff provided information for the team's Hiatus Documentation memorandum. Staff also continued examining the results of across-response matching and within-response matching in the latest matching run on the 2010 Census Unedited File (CUF). It currently appears that the latest run (2010 procedure) can serve as a baseline run for most comparison purposes. As in earlier runs, the results so far appear largely consistent with the 2010 DPI results, although the number of within-block, within-tract, and within-county within response links that would be accepted as potential matches is higher in the 2010 CUF matching. The basic patterns also appear similar in many respects to the corresponding research results based on the 2000 Census, although there are fewer within-block and within-tract links with matching phone number than in 2000. Several presumably invalid names (e.g. first name of "person", spelled out numbers in a name field) are more common in the latest 2010 matching results than they were in the 2000 research. However, the appearance of known training examples in the matching results is much less of a problem in the 2010 research than it was in the 2000 research. Staff also examined the patterns of distances between units in links from the latest 2010 across-response matching results. The distances are calculated based on the latitude and longitude information for each unit in the link. Initial results 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 prepared a draft overview of the results based on the latest 2010 matching results. Staff also reviewed the memorandum from the Decennial Statistical Studies Division “Decennial Person Computer Matching Research for Modifications to First Name Gender and Non-Gender Variant Lists.” Staff experimented with matching improvement techniques by creating a “social network” of responses from the 2010 CUF connected by multiple links between those responses.

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

1.7 AMERICAN COMMUNITY SURVEY (ACS) (Decennial Project 6385460)

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: During FY 2014, staff (a) proposed a spatial model for survey data designed to produce estimates of increased precision by smoothing over neighboring values. The spatial model for survey data was put in a Karhunen-Loeve framework in collaboration with Soutir Bandyopadhyay and Douglas Nychka. The polygonal vertices of all U.S. counties have been obtained as files and aggregate estimates of the underlying polynomial

basis functions computed over these regions. Some of these methods have been encoded in R, and a draft paper has been written; (b) devised a time series model for ACS multi-year estimates taking known sampling error variances into account that allows for interpolation and the estimation of customized period estimates. This method was implemented and tested in R.

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: During FY 2014, staff wrote a new proposal for the integration of the edit-decision module *Tea* which was engineered in-house (Klemens 2012) in the new CaRDS integrated environment for survey data processing. The proposal focused on revamping the processing operation of the American Community Survey (ACS) and was received favorably by the American Community Survey Office (ACSO). ACSO assigned a project manager to the *Tea* project and staff further developed the proposal to revamp the processing operation of the ACS with the integration of the edit-decision module *Tea*. Staff continued to integrate *Tea* into the ACS project portfolio.

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: Early in FY 2014, staff regularly participated in CAPI team discussions of CAPI contact histories to establish baseline data on the types and numbers of attempted contacts in various categories and to ascertain interview completion rates of the various types of contacts. Discussions have also elaborated types of feasible and desirable policy changes regarding curtailment of CAPI follow-up that may be successful in reducing respondent burden without undue loss of interview-responses. In Phase 3 of this work, CSRM staff were active in analysis of CAPI contact histories with respect to projected loss under various alternative curtailment policies for follow-up in CAPI using contact history data. Several of these policies involved stopping once response propensity models predict response probabilities below specified thresholds (25 percent down to 15 percent). Data analyses included calculation at national and state levels of a variety of outcomes such as non-response rates, respondent burden, numbers of contacts before and after expression of reluctance or refusal by sampled persons, etc. Using 2012 ACS data to provide information on outcomes at the national level if these curtailment policies had been used in 2012, staff tabulated various metrics of cost, respondent burden, and non-response along with calculation of response propensities and non-response biases. This work resulted in an *ACS Research Report* (Griffin et al. 2014) summarizing the comparison of metrics of the hypothetical policy outcomes. Staff did further similar analyses at the state and other sub-national levels (SSF supervisory areas, and 1-year ACS weighting areas) tabulating metrics of decreased effort and response under several different CAPI curtailment policies. This work is likely to inform near-term implementation of a large ACS field test of the most promising of the CAPI curtailment policies, and further memoranda and reports documenting research questions and results of the test.

Staff: Eric Slud (x34991), Chandra Erdman, Todd Hughes (ACSO)

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: [See General Research: Survey Sampling-Estimation and Modeling (F), The Ranking Project: Methodology Development and Evaluation]

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

E. Confidence Intervals for Proportions in ACS Data
[See General Research: Small Area Estimation (C), Coverage Properties of Confidence Intervals for Proportions in Complex Surveys]

F. Mode-Based Imputation in ACS
Description: It is well known that item non-response differs markedly between the different modes of data collection within the American Community Survey (ACS), yet current ACS practice is to perform item imputations via hot-deck methods pooling all ACS modes together. This project investigates the impact of doing ACS item-imputation separately within modes (Mail, CATI, CAPI) using the 2012 year of ACS data. It does this by developing a model-based mass-imputation approach to imputation using categorical control variables as similar as possible to those used in current hot-deck imputation and by comparing the impact on ACS estimates for selected survey variables if the mass imputation is done ignoring mode vs. being done within cells cross-classified by mode.

Highlights: During FY 2014, staff proposed this research project, discussed data requirements and goals with ACS principals, and drafted a specific ACS Research and Evaluation Plan to examine the impact of mode-based item-imputation on survey estimates for approximately 20 survey variables known to have different mode-based patterns of item non-response. This project was approved within the 2014 ACS process. Based on the full year of ACS 2012 panel data, staff have analyzed many of the survey variables by fitting CART and generalized-linear models to the complete-case data for which the variable and its most important predictors were observed. Research on the project is continuing and will be documented in a summary ACS report in early FY 2015.

Staff: Eric Slud (x34991) and Ryan Janicki

G. Voting Rights Section 203 Model Evaluation and Enhancements Towards Mid-Decadal Determinations
Description: Section 203 of the *Voting Rights Act* asks for determinations relating to limited English proficiency and limited education of specified small domains (race and ethnicity groups) for small areas such as counties or minor civil divisions (MCDs). Section 203 seeks to determine whether or not small areas must provide voting materials in languages other than English. Previous research undertaken provided a small area model-based estimate derived from American Community Survey (ACS) 5-year data and 2010 Census data, which provides smaller estimated variances than ACS design-based estimates in many cases. Research and groundwork into the production mid-decade determination is ongoing.

Highlights: During FY 2014, the paper "Statistical Modeling Methodology for the Voting Rights Act Section 203 Language Assistance Determinations" was published in the January 2014 edition of the *Journal of the American Statistical Association* under authors Patrick M. Joyce, Donald Malec, Roderick J.A. Little, Aaron Gilary, Alfredo Navarro, and Mark E. Asiala. This document represents a presentation of statistical procedures used in making the 2011 determinations of which jurisdictions need to provide voting materials in languages other than English.

Meetings are ongoing amongst several Census Bureau staff in regards to review of previous (FY 2011) application, planning for the next application, and formulating research plans to address issues and desires of staff. Further, personnel are consulting with the Department of Justice concerning the FY 2011 determinations and any adjustments to the particular nuances in relation to potentially covered persons for planned FY 2016 determinations under Section 203 of the *Voting Rights Act*.

Staff: Patrick Joyce (x36793), Eric Slud, Tommy Wright, Aaron Gilary, Tom Louis (ADRM)

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

A. 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 non-response and population controls.

Highlights: During FY 2014, research on the topic of optimization-based single-stage weight adjustment continued with the Demographic Statistical Methods Division (DSMD) staff for a Joint Statistical Meetings (JSM) paper on application of the method proposed for CPS (Slud et al. 2013, JSM) to the American Housing Survey (AHS). Staff consulted regularly with DSMD staff on applying the method to AHS data, concentrating on the creation of approximate controls, some of which in AHS are synthetic, i.e. derived from multiple sources rather than by design-based estimation from a single source. The work resulted in a JSM paper (Shaffer et al. 2014, JSM) comparing estimates using the weight adjustment method of (Slud et al. 2013, JSM) to the AHS production estimates. The differences were not large and are the subject of continuing research.

Staff: Eric Slud (x34991), Yang Cheng (DSMD), Brian Shaffer (DSMD)

1.9 NATIONAL SURVEY OF COLLEGE GRADUATES (Demographic Project 7491010)

Description: Staff will develop models that predict response mode prior to and throughout the NSCG data-collection period. The primary objective is to determine whether we can assign sample members to their preferred mode as quickly as possible to shorten the data-collection period while maintaining response rates and representativeness.

Highlights: During FY 2014, staff analyzed survey responses from the American Community Survey (ACS) and the prior wave of the National Survey of College Graduates (NSCG) to evaluate missingness and to determine appropriate recodes and transformations for model fitting. We then fit a variety of multinomial logistic regression, random forests, and survival regression models to determine which variables were most strongly associated with response mode and time to response, and which methods most accurately predicted these response behaviors.

Staff: Chandra Erdman (x31235), Stephanie Coffey (DSMD)

1.10 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: During FY 2014, staff identified some open questions for the next phase of the project in the memorandum "Protecting the PUMS By Attacking Them". The main criticism of this method of re-identification would be very expensive to an attacker. Typically, an attacker may only be interested in one individual, family, or small area. It would be less expensive to just purchase that data from an online source. An analysis of low-cost attacks or putting a cost on the methods of attacks may be of value. In principal, of course, we protect the PUMS. Another question is: Are our PUMA areas large enough to prevent attacks? Also, can tabular data be used to enhance our PUMS microdata by giving more specific geographic information to an attacker?

Staff: Ned Porter (x31798), Rolando Rodríguez, Marlow Lemons (CDAR)

1.11 NATIONAL CRIME VICTIMIZATION SURVEY (Demographic Project 7523013)

A. Analyzing the Effects of Sample Reinstatement and Process Monitoring and Fitness for Use

Analyzing the Effects of Sample Reinstatement

Description: Over the past five years, the National Crime Victimization Survey (NCVS) has been affected by several important changes with possible impact on victimization measures for households and persons. In 2010 and 2011, the sample size was restored (increased) to previous levels. In 2011 and 2012, a program of interviewer refresher training and enhanced performance monitoring was phased in by a randomized experiment. In 2012, realignment imposed by the closing of six Regional Offices brought changes to interviewer workloads. Through analysis of survey outcomes and paradata, we seek to quantify the effects of reinstatement and realignment on data-quality metrics and victimization rates.

Highlights: During FY 2014, staff finalized two technical reports: one on the effects of the refresher training experiment in 2011 and one on the effects of training and field realignment in 2012. These analyses required the development of novel hierarchical Bayesian longitudinal models for paradata measures and survey outcomes at the interviewer level. Results were presented to the NCVS Data Review Panel in March 2014. Technical reports were synthesized for submission to a peer-reviewed journal.

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: During FY 2014, a new research effort to investigate the effects of interviewer experience began. Anecdotal evidence suggests that newly hired interviewers report more crime incidents than their more experienced counterparts. Drawing upon insights from the literature on causal inference, we implemented new methods for estimating the dose-response relationship between interviewer experience and reporting of crimes, adjusting for compositional differences in the types of cases assigned to the interviewers. We investigated two

estimators of the pointwise causal dose-response function: one using a generalized propensity score defined in several articles by Hirano and Imbens, the other using a propensity measure developed by Imai and van Dyk. In consultation with the Demographic Surveys Division and the Demographic Statistical Methods Division, new priorities in fitness-for-use research have been considered for FY 2015.

Staff: Joe Schafer (x31823), Isaac Dompreh

B. National Crime Victimization Survey (NCVS) Adaptive Design Research

Description: A cross-directorate team has been established to develop and evaluate models that predict near-real-time response propensities in the National Crime and Victimization Survey. The team will monitor daily propensities along with actual survey response indicators and survey outcomes to (1) evaluate model accuracy and determine whether the models need refinement; (2) investigate relationships between response propensity and key survey variables; and (3) determine how the propensities may be used to manage fieldwork.

Highlights: Prior to 2014, the NCVS collected paradata with the Contact History Instrument (CHI). In 2014, the survey began collecting contact history records with the person-level CHI, or pCHI. During FY 2014, staff explored the new data and examined effects of fitting response propensity models with person-level rather than household-level records. Findings were presented at an internal seminar.

Staff: Chandra Erdman (x31235), Isaac Dompreh, James B. Lawrence (CSM), Peter Miller (ADRM), Tamara S. Adams (CSM), Barbara C. O'Hare (CSM), Travis Pape (CSM), William R. Samples (ADDP)

1.12 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: During FY 2014, staff completed a research report that summarized results and methods devised in FY 2013. Staff also hosted Jianhua Huang to discuss functional data analysis methods for modeling and forecasting fertility curves. His methodology was implemented on the data, with similar results. Further collaboration is planned.

Staff: Tucker McElroy (x33227), Osbert Pang, William Bell (ADRM).

1.13 SOCIAL, ECONOMIC, AND HOUSING STATISTICS DIVISION SMALL AREA ESTIMATION PROJECTS (Demographic Project 7165014)

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: Historically, one of the predictors in the SAIPE production model was the previous Decennial Census long-form estimate of poverty. The last Census long-form was over a decade ago. The American Community Survey (ACS) now provides similar information on a continuous basis that had been collected by the Census long-form survey. At small levels of geography (e.g., county), the sampling variance for the ACS estimates are non-trivial for the smaller (sample size) areas. Staff developed different modeling techniques to handle the varying uncertainty of the ACS estimates across different areas. One approach is to jointly model the current year poverty estimate and the previous (non-overlapping) 5-year ACS estimate in a bivariate model. A second approach is a measure error model. Staff is comparing results of these two approaches along with the current production model. Staff has also investigated models which look at borrowing information over time with data from the American Community Survey. In doing so, a question arises: how much past data should be incorporated into the model? Staff implemented a few variations of a Binomial/Logit Normal (BLN) Small Area Estimation AR(1) model to 2005-2010 one year ACS estimates for school-aged children in poverty though a hierarchical Bayes approach, using JAGS and R. The objective is to determine which approach gives the best prediction for the most current year of ACS. Staff compared posterior means and standard errors of the AR(1) model with those of the bivariate model and also did theoretical calculations to shed light on potential MSE improvements from using an AR(1) Fay-Herriot model vs. a bivariate model vs. a univariate Fay-Herriot model, as a function of relevant model parameters. Staff have presented selected results at the Small Area Estimation Meetings in Poznan, Poland.

Staff: Jerry Maples (x32873), Carolina Franco, William Bell (ADRM)

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: During FY 2014, staff improved upon previous benchmarking work, which constructed modified posterior distributions at distinct geographic levels so that the parameters of these adjusted distributions satisfy given functional constraints. A new numerical study, which incorporates a skew-normal distribution into the data generating process to ensure the data violate the benchmarking constraint, was designed to illustrate the effectiveness of the new procedure. A paper documenting this work was written and submitted for publication.

Comparing Small Area Estimates Over Time
Highlights: During FY 2014, staff worked on developing methods for combining cross-sectional and time-series survey data to improve the precision of current year estimates, and to construct valid credible intervals for year-to-year change. Linear mixed effects models with a first order autoregressive process linking data over time were fit to ACS data over different time horizons, and EBLUPs and estimates of their mean squared errors were computed. A numerical study was designed to understand the finite sample performance of the estimates.

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: During FY 2014, staff created a new set of geographies from the artificial population (pseudo weighting areas, pseudo counties and pseudo tracts) by merging existing geographic entities (counties, tracts) in order to produce samples with similar sample sizes for tract level estimates as the production 5-year American Community Survey. Staff also made major modifications to the code-base that draws the samples from the artificial population. Staff implemented an improved version of the procedure that simulated ACS-like samples from the artificial population. Staff ran the simulation to create 1000 samples from the artificial population for the newly defined geographies. Three different versions of the sampling variance will be supplied: the design-based (replicate weights) estimate, an estimate based on a generalized variance function (GVF) and the true sampling variance (based on the variance of the 1000-point estimator from the simulated datasets). Having these three different versions for the sampling variance will allow the staff to do interesting comparisons. For example, at very small sample sizes, do the GVF estimates perform better than the direct replicate weight estimates of the sampling variance? In addition, we can assess how much of a price in the quality of our estimates we pay for having the estimate the sampling variance (by comparing estimates that use the true sampling variance). Staff are currently implementing and running several different models to make predictions for these artificial tracts based on the simulated samples. In FY 2015, staff will perform an evaluation on these different methods to determine which models produce the best estimates of poverty at the tract level. Staff wrote a draft paper titled "An Empirical Artificial Population and Sampling Design for Small-Area Model Evaluations" by Maples, Franco, Basel, Posey and Wieczorek detailing the construction of the artificial population and how the samples were drawn to replicate the ACS design.

Staff: Jerry Maples (x32873), Ryan Janicki, Aaron Gilary, Carolina Franco, William Bell (ADRM)

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: During FY 2014, staff extended the model-assisted framework of Kim and Rao (2012) to be fully model-based. Staff implemented a fully Bayesian unit level model to predict the probability of being disabled. To properly model the individual data from the Survey of

Income and Program Participation (SIPP), the complex design of the survey needs to be included in the model specification to remove any effects of informative sampling. Staff tested many different explanatory predictors and found that age (third-order polynomial) and the six American Community Survey (ACS) questions of disability to be the strongest predictors of the SIPP definition of disability. Additionally, area level covariates from the Census Planning Database and from the Social Security Disability Insurance dataset were found useful in prediction. Staff also extended the work on the bivariate area level model (jointly modeling disability estimates from the SIPP and the ACS as outcomes) for disability in two ways: 1) staff modeled the disability rate at the county level to generate predictions for counties not in the SIPP sample and 2) staff examined models for a rate of a specific disability (e.g., wheel chair use, blindness or deafness) at the state level.

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

1.15 TIME SERIES RESEARCH (Economic Project 2320452)

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: During FY 2014, staff provided support seasonal adjustment and software support for users within and outside the Census Bureau, including AECOM, Bank of America, Care.com, IBM Research, Ancoro Impario, SAS, Nestle, Tekaura, Siemens AG, Max Planck Institute for Biophysical Chemistry, UBS, WANTED Analytics, Kohler, IMC Asset Management, Newsignature, Bureau of Labor Statistics, Bureau of Economic Analysis, California Employment Development Department, Washington State Department of Transportation, Administrative Office of the U. S. Courts, U. S. Department of Transportation, Statistics New Zealand, Service Canada, INEGI (Mexico), Statistics Sweden, Statistics Netherlands, Ministry of Business, Innovation & Employment (New Zealand), Central Bureau of Statistics (Israel), UK Office for National Statistics, Statistical Office of the Federal Employment Agency (Germany), INSEE (France), Swiss State Secretariat for Economic Affairs, Bundesbank, Central Bank of the Dominican Republic, Bank of England, Central Bank of Brazil, Hungary National Bank, South African Reserve Bank, Reserve Bank of India, Swiss National Bank, Wake Forest University, Nankai University, Yonsei University, Monash University, New Jersey Institute of Technology, Nankai University, University of Kansas, and Pakistan Institute of Developmental Economics.

Staff organized a visit for economists from INEGI, Mexico's statistical agency, and shared information on benchmarking, seasonal adjustment, and time series research on April 22-23, 2014.

Brian C. Monsell (with Demetra Lytras of OSMREP) planned and taught a class on seasonal adjustment with X-13ARIMA-SEATS at the Central Bank of the Dominican Republic from May 19-23, 2014.

David Findley visited the Statistical Research Institute, an affiliated agency of Statistics Korea, for a discussion of issues related to seasonal adjustment on July 3, 2014.

Staff organized a visit by Agustin Maravall, Chief Economist of the Bank of Spain, for the *SUMMER AT CENSUS* program on September 22-26, 2014.

Staff: Brian Monsell (x31721), James Livsey, Tucker McElroy, Osbert Pang, Anindya Roy, David Findley (Consultant), William R. Bell (ADRM)

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. The goals for FY 2014 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: During FY 2014, staff released an updated version of *X-13ARIMA-SEATS* (Version 1.1, Build 10), to the Economic Directorate for testing. They compared adjustments from this version of the software to the last released version of *X-13ARIMA-SEATS* (Version 1.1, Build 4) and found, in almost all cases, no differences in the adjustments.

Staff added a Tukey spectral diagnostic from TRAMO to a working version of the *X-13ARIMA-SEATS* program and added new revision history options to save ARMA parameter estimates and trading day regression coefficients. Staff also updated the SEATS seasonal adjustment routines within the software and changed the output for production versions of *X-13ARIMA-SEATS* when they found that certain characters could not be printed correctly.

Staff identified that differences in the seasonal adjustments for runs using automatic model identification and filter selection to runs with the resulting choices hardcoded in the spec files can be traced to differences in the extreme values identified due to differences between the default filters used in the automatic modeling runs and the final choices in the hardcoded runs. The pickmdl option will not generate forecasts for runs with poor quality.

Staff: Brian Monsell (x31721), Osbert Pang, David Findley (Consultant)

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; (9) studying nonparametric methods for estimating regression effects, and their behavior under long range dependence and/or extreme values.

Highlights: During FY 2014, staff (a) refined work on preliminary estimation of VARMA models using a Frobenious norm as the objective function. Staff also developed two novel algorithms to handle the moving average case – one based on spectral factorization, and another based on inverse Kullback-Leibler discrepancy; (b) refined research on quantifying statistical error in the visual significance graphical tool and implemented the methodology in R. Numerical work shows the importance of convexity to spectral peak behavior. New theorems were proved that extend the distribution theory; (c) developed and explored multivariate seasonal adjustment and seasonal taxonomy through custom R code to estimate dynamic factor unobserved component multivariate time series models, allowing for common trends and other general collinearities. This has been tested on aggregate retail data and regional housing starts data, to produce multivariate seasonal adjustments; (d) obtained new theoretical results concerning the positive seasonal autocorrelation-based smoothness of the model-based seasonal factor estimates and the associated propensity for oscillation ("anti-smoothness") at yearly intervals in the deseasonalized series obtained by subtraction of the seasonal factors; (e) derived new results for a multivariate bullwhip effect of multiple supply-chains incorporating nonstationary behavior, including seasonality; (f) completed research on a method of testing non-nested model comparisons via the generalized likelihood ratio test statistic; (g) completed a paper on recursive algorithms to efficiently compute block-Toeplitz precision matrices, quantifying improvements to run-time speed. Some applications to spectral factorization were also developed; (h) developed methodology for a cepstral representation for multivariate time series, which ensures the stability and invertibility of the vector stochastic process. Simulations and empirical studies for a Bayesian analysis have been completed; (i) compared revisions history statistics for X-11 and model based adjustment runs and found that model based adjustments gave smaller revisions for the majority of Census Bureau series in the study.

Staff: Tucker McElroy (x33227), James Livsey, Brian Monsell, Osbert Pang, William Bell (ADRM), 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: During FY 2014, staff produced a research report which summarizes results obtained in FY 2013.

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: During FY 2014, staff updated the *X-13ARIMA-SEATS REFERENCE MANUAL* to include information on new options and diagnostics, and updated the Seasonal Adjusted Papers site with new and updated research reports and papers. Staff updated the Genhol utility, correcting program defects before releasing an updated version of the software to the public.

An updated version of the X-13-Data program developed by the Time Series Methods Staff was made available on our website.

Staff developed a licensing statement and disclaimer for all software developed by the research staff and the Time Series Methods Staff that received the approval of the Commerce Department. This statement appears on the *X-13ARIMA-SEATS* website (http://www.census.gov/srd/www/disclaimer.html) and in the documentation of all official software.

Staff developed a configuration file to allow UltraEdit to highlight key words, comments, and text in *X-13ARIMA-SEATS* spec files.

Staff: Brian Monsell (x31721), Tucker McElroy, David Findley

1.16 ECONOMIC STATISTICAL COLLECTION
(Economic Project 1183020/2320457)

A. Research on Imputation Methodology for the Monthly Wholesale Trade Survey

Description: In this project, we propose and investigate new methodology for imputing missing data in the Monthly Wholesale Trade Survey (MWTS). The MWTS is a longitudinal survey that provides month-to-month information on sales and inventories of U.S. merchant wholesalers. Key estimates produced from this survey include total sales, month-to-month relative change in sales, total inventories, and month-to-month relative change in inventories (overall and within industry subclasses). A rich set of frame data are available from the Economic Census, which can be used to build imputation models. In developing imputation methodology for the MWTS data, there are a number of challenges, including: variables having highly skewed distributions, missing values in predictor variables from the Economic Census, and survey variables having monthly trends that differ across industry classes. The proposed imputation methods will account for these challenges, and will be evaluated and compared with the methodology that is currently used for imputation in the MWTS. It is expected that the proposed imputation methods will also be applicable to other business surveys.

Highlights: During FY 2014, staff designed a simulation study to evaluate the performance of new imputation methods previously proposed for the Monthly Wholesale Trade Survey (MWTS). Using nonparametric techniques, we constructed an artificial population to mimic the behavior of the actual population over the two-year span from December 2008 to December 2010. Because we have access to the entire population, the truth (i.e., the set of "true" values for all population target estimands) is known, providing a gold standard against which the procedures may be compared. From this artificial population, we drew 1,000 probability samples using a stratified-sample design that closely resembles the MWTS sample design. For each sample, we calculated point estimates and standard errors for key population quantities with no missing data. We then imposed non-response on each sample by a stochastic mechanism that produces realistic rates and patterns of missing values. We filled in the missing values by the current ratio-based single-imputation method and a new model-based multiple-imputation method. Finally, we computed estimates and standard errors from each imputed sample and assessed their performance for drawing inferences for the known target quantities from the pseudo-population. In the simulation study, we found that the complete data inferences, which are based on Horvitz Thompson estimates and a generalized version of the Central Limit Theorem (CLT) for stratified samples, resulted in confidence intervals having coverage well below the nominal level. The low coverage occurred because the population has an extremely skewed distribution, and the sample size was not large enough to invoke the CLT. We recommended that future research consider model-based, model-assisted, or Bayesian approaches to improve the quality of complete data inferences. We also recommended that future work examine the artificial population that we constructed to evaluate the extent to which simplifying assumptions may have impacted the results. A manuscript based on this work entitled "Evaluating Imputation Techniques in the Monthly Wholesale Trade Survey" was prepared and submitted to the *Proceedings of the 2014 Joint Statistical Meetings.*

Staff: Martin Klein (x37856), Joe Schafer, Joanna Fane Lineback (ADEP)

B. Use of Big Data for Retail Sales
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. Specifically, we are interested in how to use "Big Data" to supplement existing monthly/annual retail surveys with a primary focus on exploring (1) how to use third party data to produce geographic level estimates more frequently than once every five years (i.e. a new product), and (2) the possibility of using third party data tabulations to improve/enhance Census Bureau estimates of monthly retail sales - for example, validation and calibration. Various types of data are being pursued such as credit card transaction data and scanner data.

Highlights: During FY 2014, staff members joined Economic Directorate staff in several discussions with First Data to discuss possibilities of obtaining and using some of its data to improve retail sales estimates. First Data is a global payment processing company that 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. Staff also participated in discussions with Economic Directorate staff about obtaining data from other sources (e.g. marketing companies, credit card companies). In particular, staff served on a small team with Economic Directorate staff to develop a request for proposal seeking companies that collect transaction data, to review received proposals, and to meet with staff from the company awarded a contract. Retail data in two product categories (auto parts and jewelry/watches) were provided by the company for exploration.

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

1.17 ECONOMIC MISSING DATA/PRODUCT LINE DATA (Economic Project 2320410)

1.18 DEVELOPMENT / SAS (Economic Project 2320454)

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: During FY 2014, staff completed and delivered selective editing programs, analyses for several commodity groupings at different aggregation levels, results of an evaluation study, and a JSM proceedings paper describing methodology and results under this project. The work on "Investigation of Selective Editing Procedures for Foreign Trade Programs" is complete.

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

B. Missing Data Adjustment Methods for Product Data in the Economic Census
Description: The Economic Census collects general items from business establishments such as total receipts, as well as more detailed items such as product sales. Although product data are an essential component of the Economic Census, item response rate is low. This project investigates methods for imputing missing product data in the Economic Census. We research three methods for treating missing product line data: expansion estimation, hot deck (random and nearest neighbor), and sequential regression multivariate imputation (SRMI). Staff was asked to apply the SRMI method to these data and assist in making a recommendation.

Highlights: During FY 2014, staff was asked to join the project team. In preparation for empirical research, staff: prepared presentations on multiple imputation and SRMI, prepared a document describing the SRMI methodology, examined the questionnaires in scope, selected IVEware as the appropriate software to implement SRMI as it is callable from SAS as per the Economic Directorate requirement, prepared the software for use on the Economic Directorate's server, and assisted in selecting evaluation criteria and an appropriate evaluation methodology for imputation method comparisons. Staff assisted in exploratory data analysis and response propensity models, contributed ideas and suggestions for dataset formatting, began programming SRMI in IVEware, researched the approximate Bayesian bootstrap as a way to use the hot deck and expansion methods in a multiple imputation setting, arranged meetings with SRMI and multiple imputation experts, and led the SRMI research subteam. By the end of FY 2014, programs were complete and CSRM staff assisted in running analysis. Preliminary results were presented to Economic Directorate leaders and stakeholders.

Staff: Darcy Steeg Morris (x33989), Maria Garcia, Yves Thibaudeau

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

A. Governments Division Project on Decision-Based Estimation

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 2014, staff provided additional consulting to GOVS concerning R codes for variance estimation in the decision-based estimation method. The previously submitted *Survey Methodology* paper on this method was accepted. Work on this project is now complete.

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

1.20 TOBACCO USE SUPPLEMENT (NCI) SMALL DOMAIN MODELS (National Cancer Institute Project 7275001)

A. Tobacco Use Supplement (NCI) Small Domain Models

Description: Staff is working 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: During FY 2014, staff obtained and incorporated 2010-2011 CPS data including outcome variables and weighting information, and new covariate data from the ACS. Staff developed a probability small-area model as part of an evaluation of new stepwise input models for 2010-2011 (using different variable sets, scales, and variance calculations) for further testing and comparisons. Staff developed a framework for testing a suite of different small area models under different conditions and selected the models that performed best under diagnostic tests.

Staff implemented Markov Chain Monte Carlo convergence diagnostics and other model diagnostics to evaluate each of the models. Staff also devised methods for benchmarking estimates to higher levels of geography based on the methods described in You, Rao, and Dick (2004), and later developed and implemented a hierarchical benchmarking structure using regional- and state-level estimates. This structure involved the creation of state-level models, and regional-level design effects, for all of the outcome variables.

Staff developed a set of estimates based on these procedures which will become the final deliverable pending staff and NCI review and disclosure protection processes.

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

1.21 ASSESSMENT OF FINANCE METHODOLOGY (Administration and CFO Project TBA)

A. Assessment of Finance Methodology

Sampling Plan to Assess the Census Bureau's Method for Estimating Accruals

Description: Staff members were asked to develop and carry out statistical methodology to validate the Finance Division's current methodology for estimating Census Bureau's total FY 2012 accruals as of September 30, 2012. The total FY 2012 accruals is the total expenses for work done on contracts or purchase orders that have occurred, but have not been paid. Without contacting every contractor, there is no way to know this total with certainty. So to estimate this total, Finance Division has multiplied the total value of all contracts and purchase orders that have not been paid as of September 30, 2012 by an average (over five prior years) estimate of the ratio of amount paid on contracts/purchase orders (through the fourth quarter) to total values of contracts/purchases.

Highlights: During FY 2014 and using data provided by Finance Division, staff members determined a stratified random sampling plan (with desired sample size) to estimate a 95% confidence interval for the total accruals. The interval from the stratified random sample contained the estimate that Finance Division had obtained, and it was used as the basis for validating its methodology. The complete details are contained in the final December 2, 2013 memo to the Finance Division "A Sampling Plan to Assess the Census Bureau's Method for Estimating Accruals." Staff completed a similar study and a validation for FY 2013 accruals. The complete details are contained in the final September 12, 2014 memo to the finance division, "A Sampling Plan to Assess the Census Bureau Method for Estimating Accruals".

Analysis of Some Sample Data to Assess NOAA's Method for Estimating Accruals

Description: Our staff members were asked to develop and carry out statistical methodology to validate NOAA's current methodology for establishing NOAA's total FY 2012 accruals as of September 30, 2012. The NOAA methodology is similar to, but different from, that of the Census Bureau. NOAA's focus is more on the amount actually paid during a time period and uses this as a "proxy" for accruals. Instead of using five years of prior year data, it uses data from FY 2011 to obtain a ratio which is used to multiply the total value of all contracts and purchase orders that have not been paid as of September 30, 2012 to estimate its FY 2012 accruals.

Highlights: During FY 2014 and using data provided by NOAA, staff members analyzed data and determined a 95% confidence interval which similarly contains NOAA's estimate using its methodology, and hence a validation of it. The complete details are contained in the final memo to NOAA – "An Analysis of Some Sample Data to Assess NOAA's Method for Estimating Accruals."

Staff: Tommy Wright (x31702), Carolina Franco, Michael Leibert, Sandi Walters (FIN), Robin Guinn (FIN), Phan Ma (NOAA), and Kim Darling (NOAA)

1.22 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, Lauren Emanuel

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 2014, the IT High Performance Computing (HPC) project team assembled and tested a working prototype of the next research computing platform to be used for ADRM (and others). The prototype system consisted of four compute nodes, a PBS server, a MySQL server, and a login server. The system will be referred to as the Integrated Research Environment (IRE) when it goes into production. Several researchers from CSRM and the Center for Economic Studies (CES) performed "real world" testing by running jobs on the prototype that they had run before on existing systems. As expected, compute performance was about the same because the hardware was similar. One of the tests highlighted the need for faster disk storage such as solid-state disk drives (SSDs), which are much faster than the current SAN based storage. It is likely that SSDs will be incorporated into the production system as a resource. The IRE project team is actively developing the authorization and data access model aspects of the new system, which is expected to introduce technical controls to prevent unauthorized commingling of data from different projects. The IRE will integrate with the CES Management System (CMS) and the Data Management System (DMS) to provide project authorization and provisioning features. Development is ongoing.

Also in FY 2014, all Windows desktops were migrated from Windows XP to Windows 7, in either the "full client" or "thin client" configuration. Microsoft ended support for Windows XP on April 8.

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: During FY 2014, staff completed work on selective editing of Foreign Trade data, delivered selective editing software, analyses for data at different levels of aggregations, and a report/Joint Statistical Meetings (JSM) paper describing methodology and results. We also revised existing computer programs for generating implied ratio edits using a shortest path algorithm, including updating 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: During FY 2014, staff extended the model of Mariano and Kadane (2001) to apply it in the context of the decennial census. Based on that model, staff proposed formulas to estimate propensities and costs of future waves of contact attempts. Data from at least two waves are needed to estimate the parameters of the Mariano Kadane model. Given those estimates, if the model is correct, the formulas can be used to make decisions to initiate additional waves of contact attempts in the field, based on the estimates of future cost and future productivity derived through the formula.

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

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 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 of 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: During FY 2014, staff sent detailed information about re-identification methods for rank-swapping and micro-aggregation to Professors Hang Kim, Alan Karr, and Jerry Reiter who were attempting to develop methods that were a special case of previously developed methods. The methods (see *Center Report Series #RRS 2002-08*) have been independently confirmed by Professors K. Muralidhar and J. Domingo-Ferrer.

Staff refereed a paper for the *International Statistical Review*. Staff provided some papers and explanatory comments to CSRM staff who look at differential privacy methods. Staff refereed three papers for *Statistical Data Protection 2014*. Staff provided some papers and explanatory comments to two contractors who are planning workshops and working with several government agencies including the Census Bureau. One staff member prepared slides and background material for his invited roundtable on microdata confidentiality at the Joint Statistical Meetings in August 2014.

One staff member updated and distributed his list of microdata confidentiality references to groups at several universities, think tanks, and government agencies.

Staff: William Winkler (x34729), William Yancey

B. 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: During FY 2014, staff reviewed ten papers in the literature for adjusting statistical analyses for record linkage error; two extend prior informed imputation methods. Staff gave very extensive advice, lists of references, and background papers on statistical matching, confidentiality, and record linkage for a course taught by Professor Partha Lahiri at the Joint Program on Survey Methodology at the University of Maryland. A staff member also gave one lecture and demonstrated our production software that has been used in short courses at the University of London and other locations.

Staff sent comments on *BigMatch* and methods of parallel computation to a group of computer scientists at the University of Notre Dame who have developed methods of performing analyses (parallel) on *Big Data*. One staff member sent comments and information on string comparator metrics to Professor Peter Christen and one of his graduate students at the Australia National University. One staff member sent information and comments about methods/computational-algorithms to Professor Dan Reznik who is developing record linkage software for the Brazilian government.

One staff member wrote an overview chapter entitled "Probabilistic Linkage" which will appear in a monograph that will cover applications of record linkage in the health sciences. Another staff member wrote an overview paper on record linkage that appeared in *Wiley Interdisciplinary Reviews: Computational Statistics*. One staff member served as a discussant in an invited paper session at the 2014 Joint Statistical Meetings on capture-recapture and record linkage.

One staff member provided *BigMatch* and other record linkage software to several university groups under a limited use license. He also provided advice on the applications of the methods. He also sent extensive software (including data preparation software) to a research group at Statistics Canada.

Staff provided very extensive advice to groups who are developing methods for some of the Bureau's newer systems, particularly those involving real-time implementation. In talks at the FCSM Conference in November 2013 and in the closing talk at the SAMSI-sponsored "Computational Methods for Censuses and Surveys" in January 2014, a staff member described the extreme speed breakthroughs in our software used for production and analysis. With the new software, a team of suitably skilled individuals can clean-up and begin

preliminary analysis on a set of national files in 3-6 months; with far slower software it is not clear how long such work would take. *BigMatch* technology (Yancey and Winkler 2009) used for 2010 Decennial Matching extends to a large number of real-time situations being researched. In particular, *BigMatch* is 500 times as fast as methods used in several government agencies, 50 and 10 times as fast as experimental parallel software from Stanford and Leipzig (Kolb and Rahm 2013) while still being portable across machines. DISCRETE modeling/edit/imputation technology (Winkler 2003, 2008, 2010) has four algorithms that are each on the order 100 times as fast as the previously fastest algorithms.

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

C. 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: During FY 2014, one staff person gave a very extensive number of comments to three groups at Carnegie Mellon University that are working on record linkage. Staff provided many comments related to methods for speeding up computation. One staff member wrote JAVA routines for Professor Rebecca Steorts to speed up her computations and another sent her several papers on blocking for record linkage.

Staff gave very extensive comments on modeling/edit/imputation for continuous economic data and discrete demographic data to researchers at Duke/NIST who are working on a five-year NSF grant.

Staff sent extensive reference materials, comments on methods and programming to two groups at Statistics Canada (STC) who are working on record linkage for economic (business) data and for demographic/decennial data. Some STC individuals are trying to reproduce the parameter-estimation and error-rate estimation methods of Winkler (1988, 1993, 2002, 2006). In particular, the parameter-estimation methods used for EM unsupervised learning of "optimal" record linkage parameters for the Decennial Census and other applications slightly generalize and use far faster computational algorithms than the methods of Kim Larsen (SIGKDD Explorations 2005). His method "Generalized Naïve Bayes Classifiers" uses Generalized Additive Models to get the best conditional independence (naïve Bayes network) for approximating general Bayes Networks for classification.

Staff gave an extensive number of comments to a group at Carnegie-Mellon University that is working on fast computational methods record linkage. Some of the comments were related to the speed of *BigMatch* in comparison to experimental record linkage at universities using parallel algorithms. *BigMatch* is still much faster and does not necessitate special hardware. Staff reviewed a paper by Brad Malin (former CS Ph.D. student at CMU) and some of his colleagues on load-balancing methods for parallel computation that are intended to improve over those of Kolb and Rahm (2013).

Staff has given very extensive comments on modeling/edit/imputation for continuous economic data and discrete demographic data to researchers at Duke/National Institute of Statistical Sciences who are working on a Census Bureau funded five-year NSF grant. A staff person pointed out additional needs of the Economic Censuses in terms of producing numbers that can be used in many interconnected tables (controlled rounding according to Winkler 1986, 1987 or Deville and Tille 2004 *Biometrika*), needed computational speed, and various integer programming methods that assure individual records satisfy edits. At the FCSM conference in November, Dr. Winkler served as discussant in an invited session that had two papers on modeling/edit/imputation and one on editing/confidentiality.

The original SPEER routines needed a major speed breakthrough to maintain the quality of other integer programming methods while allowing each of the Economic Censuses (with a total of 8 million records) to be processed in 12 hours or less. The very fast SPEER software was 60 times as fast as Statistics Canada's GEIS system (Kovar and Winkler 1996) and 600 times as fast as software in at least one other National Statistical Institute. The new university routines appear to be yielding much better joint distributions and aggregates than other groups have achieved. Speed may need enhancement by a factor of 4-5 magnitudes because the new MCMC methods appear to need two minutes per record.

One staff person refereed a paper for the *Journal of the American Statistical Association* and prepared an overview of theory and practical applications of edit/imputation in the statistical agencies in the last 35 years.

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:
A Measurement Error Approach to Small Area Estimation
During FY 2014 and starting with the measurement error (ME) model proposed by Ybarra and Lohr (*Biometrika*, 2008, pp. 919 – 931), staff explored through simulation studies the comparison among ME, observed best prediction with measurement error (OBPME), the hierarchical Bayes ME and Empirical Best Linear Unbiased Estimator (EBLUP) type estimators. Staff has shown that the double bootstrap method inspired by Hall and Maiti (*JRSS-B*, 2006, pp. 221 – 238) and Pfeffermann and Correa (*Biometrika*, 2012, pp. 457 – 472) can be used to construct a second-order unbiased estimator of the mean squared error (MSE) for a model estimate, as well as compare several methods on an even base. The method provides a computational remedy to cases where a theoretical MSE value is hard to find or results in a negative value from computation. Using this method, staff created MSE estimator for the bivariate Fay-Herriot model and studied its connection to ME model. Results from simulation as well as the application to make state-level disability estimates from Survey of Income and Program Participation (SIPP) while borrowing strength from the American Community Survey (ACS) were presented at Session 559 of the Joint Statistical Meetings (JSM) in August. A proceedings paper titled "Modeling Disability in Small Areas: An Area-Level Approach of Combining Two Surveys" by You, Datta and Maples was submitted subsequently.

Best Predictive Small Area Estimation in Measurement Error Model
During FY 2014 and inspired by a recent paper where Jiang et al. (*JASA*, 2011, pp. 732 – 745) proposed an alternative method of predicting small area means, staff expanded the simulation setup in Datta et al. (*Biometrika*, 2005, pp. 183 – 196) and compared the performance of the new predictor, named "observed best predictor" (OBP) against the Fay-Herriot model estimate. Despite the paper's claim that OBP works particularly well compared to several Empirical Best Linear Unbiased Predictors (EBLUPs) – including the Fay-Herriot model, we showed mixed findings when comparing empirical mean squared errors (MSE). Because the OBP approach has the advantage when a model is misspecified, staff recommended the use of combining the desirable feature from OBP with the idea of measurement error model where auxiliary variables are measured with uncertainty. Staff demonstrated that the combined observed best prediction with measurement error (OBPME) estimator outperforms both the measurement error model first proposed by Ybarra and Lohr (*Biometrika*, 2008, pp. 919 – 931) and OBP itself. Derivation of the proposed model and simulation results were documented. Selected results were presented at the 2014 annual meeting of Statistical Society of Canada in Toronto in May.

Methods for Detecting Departures from Normality in Small Area Models
During FY 2014, staff developed novel methods for detecting departures from normality of the model error terms in linear mixed effects small area models. Staff showed that, under the assumption that the residuals from a fitted model can be represented as a common transformation of Gaussian data, the transformation function can be expanded in a basis of orthogonal polynomials and consistently estimated from the observed data. This semiparametric estimate of the transformation function, along with the estimated error

bounds, can be compared to the reference diagonal and used as a graphical tool for detection for departures from normality of the error terms. Results were presented at the Joint Statistical Meetings.

Staff: Jerry Maples (x32873), Aaron Gilary, Ryan Janicki, Gauri Datta, Jiashen You

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: Work on this project was suspended during FY 2014.

Staff: Eric Slud (x34991), Gauri Datta

C. Coverage Properties of Confidence Intervals for Proportions in Complex Surveys
Description: This is primarily a simulation project to investigate the coverage behavior of confidence intervals for proportions estimated in complex surveys. The goal is ultimately to inform recommendations for interval estimates in the American Community Survey (ACS), so the issues of main interest are: (i) whether the current Wald-type intervals (defined as a point-estimator plus or minus a margin-or-error (MOE) estimate) can be improved by empirical-Bayes modifications or by modified forms of intervals known to perform well in the setting of binomial proportion-estimators, (ii) whether failures of coverage in a simulated complex survey can be ascribed to poor estimation of effective sample size or to other aspects of inhomogeneity and clustering in proportions within realistically complex populations, and (iii) whether particular problems arising with coverage of intervals for small proportions can be overcome. Future research might address whether the confidence interval methods developed for single-domain design-based estimates can also be adapted to small area estimates that borrow strength across domains.

Highlights: During FY 2014, staff designed and implemented a simulation that aims to control and measure the impact of the main factors that are thought to influence the performance of confidence intervals, such as clustering, stratification, the degree of heterogeneity within and between clusters and among strata in the population, etc. The simulation mimics some of the features of ACS. Staff studied the degree to which misspecification of the design effect leads to problems in coverage. We evaluated the performance of several intervals across many scenarios using a simulation with a factorial design with 864 different configurations. We presented preliminary results at the 2014 Joint Statistical Meetings in Boston, and published them in a corresponding proceedings paper. We began further analysis to be included in a journal paper submission.

Staff: Carolina Franco (x39959), Eric Slud, Thomas Louis (ADRM), Rod Little (University of Michigan)

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. Interviewer Observations Research
Description: An inter-agency team was formed to develop a set of interviewer observations for face-to-face surveys. The goal is to identify a set of measures that can be collected for all households in sample (both responding and non-responding households), and that predict the likelihood of both survey cooperation and key survey responses. Once such measures are identified, they may be used to manage data-collection resources and in non-response bias adjustments.

Highlights: During FY 2014, the team developed a set of observations that have since been added to the Contact History Instrument. After collecting the observations for several months, the team estimated a set of response propensity models to isolate the predictive power of the new observational measures and examined poly-choric correlations between the new measures and key outcomes from the National Health Interview Survey. In addition, staff examined the relationship between response propensity and key survey outcomes. The analysis was presented at the annual conference of the American Association for Public Opinion Research.

Staff: Chandra Erdman (x31235), Nancy A. Bates (ADRM), Barbara C. O'Hare (CSM), Peter Miller (ADRM), Rachael Walsh (CSM), Karen Ann Bagwell (CAD), James Dahlhamer (NCHS), Renee Gindi (NCHS)

B. Household Survey Design and Estimation
[See Demographic Projects]

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 non-response 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: During FY 2014, staff continued collaborating 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, but the initial parameter settings for the M-estimation algorithm affect its performance. Subsequently, staff developed a general methodology that uses historical data to determine the initial parameter settings for the M-estimation algorithm parameters and is capable of accounting for seasonal effects. Currently, the team is examining three methods for determining M-estimation parameter settings using 36 months of empirical data from 19 industries in the Monthly Wholesale Trade Survey (MWTS). The method chosen will be used for a side-by-side test conducted in real time during MWTS data collection.

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: During FY 2014, staff worked with a *SUMMER AT CENSUS* scholar who developed some visualizations for one of the ranking methods. Staff reviewed more of the ranking literature and worked on the following draft manuscript for submission to a journal – "Ranking Populations Based on Sample Survey Data." A literature review of ranking methods was undertaken and integrated into this manuscript. Staff was successful in organizing an invited session for the 2015 International Statistical Institute World Statistics Congress. Staff will give the invited paper in the session with four discussants.

Staff: Tommy Wright (x31702), Martin Klein, Jerzy Wieczorek (Carnegie Mellon), Derrick Simmons, Nathan Yau

E. 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: During FY 2014, staff members worked to demonstrate that it is very easy to extend and generalize the result in Wright (2012) to the problem of finding an exact optimal allocation to minimize the sampling variance under stratification with any mixed constraint patterns. Avoiding the costly tendency to round up to ensure maximum sampling variance, the exact optimal allocation is especially useful in applications where the number of strata is very large and there are minimum and maximum size constraints for the sizes of the sample to be allocated to each stratum. The new methodology was applied to the Service Annual Survey.

Staff considered the development of a computer program to allocate a sample to strata to minimize sampling variance subject to a cost constraint. Staff gave a complete and direct proof of the equivalence of Webster's Method and Willcox's Method of Major Fractions for apportioning seats in the U.S. House of Representatives.

Staff: Tommy Wright (x31702), Pat Hunley, Michael Leibert

F. Interviewer-Respondent Interactions: Gaining Cooperation

Description: Survey non-response rates have been increasing, leading to concerns about the accuracy of (demographic) sample survey estimates. For example, from 1990 to 2004, initial contact non-response 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: Work on this project was suspended during FY 2014.

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. Development of *Tea*
[See Decennial Directorate Collaboration Project 651040 Coding, Editing, and Imputation Study: (A) Software Development (*Tea)* and (B) Software Analysis and Evaluation]

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: During FY 2014, staff proposed an additional initiative for operational efficiency (IOE) involving R: that Census Bureau processes be made interoperable with open source processes. This IOE has the potential to save costs by using functional processes at no cost and integrate them in our systems. This initiative was ranked in the top 25 IOE and was recognized at the Innovation Fair in August 2014. The initiative is an umbrella for a comprehensive strategy that includes integrating new open-source edit and imputation software (*Tea* project), adaptive-design open-source software (Erdman 2013, 2014), and *STATA* publically-available software into the new enterprise system, CARDS, being developed by the Census Bureau..

Staff: Yves Thibaudeau (x31706), Chandra Erdman, 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: During FY 2014, staff (a) continued research on a method to fit time series models such that signal extraction revisions are minimized (joint work with the Economic Directorate); (b) examined the cause of discrepancies between seasonal adjustments based on two automatic procedures in *X-13ARIMA-SEATS*; (c) studied comparisons of the impact on seasonal adjustment of built-in Easter regressors with user-defined Easter regressors; (d) investigated the impact of omitting trading day components on concatenated growth rates; (e) developed and implemented a technique of seasonal adjustment for multiplicative series with zero values via utilizing truncation together with missing value imputation. This was applied to New Zealand agricultural data; (f) constructed a web application that displays the weighting of seasonal adjustment filters; (g) created graphs which displayed the seasonal adjustment filters on series extended by forecasts for ARIMA models with their coefficients fixed at different values.

Staff: Tucker McElroy (x33227), James Livsey, Brian Monsell, Osbert Pang, Anindya Roy

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: During FY 2014, staff (a) formulated methods to estimate long memory parameters via a semiparametric framework of log spectral density estimation; (b) completed theoretical and empirical work on spectral density estimation theory using fixed bandwidth ratio asymptotics as well as a development of vanishing bandwidth. 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) implemented and tested new methodology for computing the autocovariance function of a multiple-pole long memory time series. This methodology was explored on a diverse set of time series; (e) developed parameter estimation methodology for renewal count time series models and further developed the study of multivariate count time series; (f) developed and refined general measures of time series goodness-of-fit by exploring the serial correlation and marginal structure of time series residuals; (g) began research into Wiener-Hopf factorization with applications to fast fitting of VARMA models as well as admissible decompositions for signal extraction; (h) derived limit results for quadratic functionals of multivariate spectra with applications to discrimination analysis and fitting of multivariate time series; (i) examined hypothesis tests for determining if a series had equal variances for each month versus an alternative hypothesis of unequal variance; (j) continued extensions of multivariate direct filter analysis, and began contributions to a monograph on the topic.

Staff: Tucker McElroy (x33227), David Findley (Consultant), Brian Monsell, James Livsey, Osbert Pang, Anindya Roy

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: During FY 2014, staff presented some of the methods developed in FY 2014 in a variety of public venues.

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: During FY 2014, staff submitted revisions for the manuscript presenting this research. The manuscript appeared as a publication and research on this project is now complete.

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: The manuscript for this work has been accepted for publication in the *Journal of Official Statistics* and is expected to appear this year. Research on this project is now complete

Staff: Derek Young (x36347), Thomas Mathew

D. Multivariate Nonparametric Tolerance Regions
Description: A tolerance region for a multivariate population is a region computed using a random sample that will contain a specified proportion or more of the population, with a given confidence level. Typically, tolerance regions that have been computed for multivariate populations are elliptical in shape. A difficulty with an elliptical region is that it cannot provide information on the individual components of the measurement vector. However, such information can be obtained if we compute tolerance regions that are rectangular in shape. This project applies the notion of data depth to compute multivariate tolerance regions in a nonparametric framework. Such an approach can be applied to multivariate economic data and aid in the editing process by identifying multivariate observations that are outlying in one or more attributes and subsequently should undergo further review.

Highlights: During FY 2014, staff developed a general algorithm for computing the multivariate nonparametric tolerance regions that are rectangular in shape. The concept of data depth was used for this purpose. Staff carried out an extensive simulation study based on different depth functions and showed that the coverage probabilities are close to the nominal as long as the sample size is reasonable large. As expected, coverage probabilities are affected by lower sample sizes and

larger data dimensions. Since data depth calculations are typically computationally-intensive, staff focused on those depth procedures that are more efficient. Staff also explored the possibility of using a bootstrap calibration to improve the coverage probability. Due to the discrete nature of this procedure, the bootstrap calibration does not appear to consistently correct conservatism observed in the coverage probabilities. Staff is in the process of writing up a manuscript based on this work.

Staff: Derek Young (x36347), Thomas Mathew

E. 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: During FY 2014, staff continued theoretical work toward the development of new and exact methods for drawing parametric inference based on singly imputed partially synthetic data. There are some examples of partially synthetic data products where only a single synthetic dataset is released. Current state of the art methods for drawing inference require that multiple synthetic datasets be released and thus do not apply if only a singly synthetic dataset is available. The new methods we have developed address this issue by allowing a data user to draw valid inference based on only a single synthetic dataset under some parametric models. Releasing a single (instead of multiple) synthetic dataset is sometimes desirable in order to reduce the amount of disclosure risk. We derived and implemented (in the statistical computing software R) their new methodology under four important scenarios: (a) original confidential data follow an exponential distribution, (b) original confidential data follow a normal distribution, (c) original confidential data are jointly distributed as multivariate normal, and (d) original data satisfy a multiple linear regression model where the response variable requires protection and a set of non-sensitive regressor variables is available. Within each scenario, we considered two cases of synthetic data generation: Case 1 (posterior predictive sampling) where the synthetic data set is generated from a posterior predictive distribution under a diffuse prior distribution, and Case 2 (plug-in sampling) where synthetic data are generated by replacing unknown parameters in the parametric model by observed values of their point estimators computed on the original data. In each scenario we developed exact (finite sample) procedures for drawing inference, based on a single synthetic dataset, on the parameters of the underlying model on the original data. We developed efficient computational procedures to implement these methods using Rao-Blackwellized Monte Carlo estimators when possible to increase efficiency. Some comparisons were made between posterior predictive sampling and plug-in sampling, and it was found that plug-in sampling often leads to more efficient inferences. Simulation studies were conducted to show that the proposed methodology does in fact perform as our theory predicted. This work was written as three papers, and each was submitted for publication.

We continued work on the development of likelihood based methods to analyze log-normally distributed data where any large value (exceeding a fixed threshold) is perturbed by multiplicative random noise for the purpose of statistical disclosure control. This methodology can serve as an alternative to top coding—which is often applied to protect large income values from disclosure—and to synthetic data. We extended our previous results to the scenario where the log scale mean of the sensitive variable is described by a linear regression on a set of regressor variables. We considered two cases: (I) when each released observation includes an indicator that it was noise multiplied, and (II) when no such indicator is provided. The necessary theoretical results for drawing inference on the regression coefficients and residual variance based on the noise multiplied data were developed, efficient computational methods were developed as part of the methodology, and R code was written to actually implement the methods. A simulation study was conducted to assess the accuracy of inference obtained under the proposed noise multiplication methods, and to compare the accuracy of inference under noise multiplication with that under synthetic and top coded data. The simulation study uses a flexible distribution for generating the noise multipliers which has no probability mass in an interval containing 1, thus ensuring that the relative distance between the noise multiplied and original data value is bounded away from zero. We applied the new noise multiplication methodologies to public use data from the 2000 U.S. Current Population Survey (CPS), and showed the resulting inferences obtained for a regression of the logarithm of total household income on several covariates. We also applied four synthetic data methods, and top coding methodology (using Tobit models) to the 2000 CPS data, and compared the resulting inferences with those obtained under the proposed noise multiplication methods. Furthermore, we carried out a detailed disclosure risk evaluation of the proposed noise multiplication methods in the context of the CPS data example, and compared the disclosure risk of noise multiplication with that of synthetic data methods. As part of the disclosure risk evaluation, we defined a new way to estimate a confidential microdata value based on

released noise multiplied data. The new estimator is based on the conditional expected value of the confidential microdata variable, given the released data. We derived the theoretical expression for the estimator in our settings. The estimator incorporates information from the released noise multiplied data, information contained in covariates related to the confidential value, and information concerning the distribution used to generate the noise multipliers. We evaluated the disclosure risk of the noise multiplication method under the scenario where an intruder uses the newly proposed estimator of the confidential microdata value to attempt to recover that value. A manuscript describing this work was revised to include all of these new results, and submitted for publication. The manuscript, entitled "Noise Multiplication for Statistical Disclosure Control of Extreme Values in Log-normal Regression Samples," was subsequently accepted for publication in the *Journal of Privacy and Confidentiality.*

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

F. Master Address File (MAF) Research
Description: This project investigates time-dynamic Markovian models of frame changes in the context of a frame canvassing operation like that of Address Canvassing for the Master Address File (MAF). The objective of the research is to show how current zero-inflated models (Young et al. 2014) for block-level counts of Adds and Deletes from a single round of convassing might be subsumed into a stochastic model driven by unit-level and block level covariates that could be used in analyzing data over time.

Highlights: During FY 2014, staff initiated this research in preparing a paper and presentation for the 2014 Joint Statistical Meetings. Continuing discussions of staff with DSSD, GEO and DSMD staff on the topic of unit-level modeling of mechanisms of MAF additions and deletions may result in further FY 2015 collaborations on frame research topics related to the analysis of MAF-update databases over time with a view to estimating and forecasting frame coverage errors at higher-level geographies.

Staff: Eric Slud (x34991)

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: During FY 2014, staff worked with staff across the Census Bureau and hosted the visits of thirty-one 2014 *SUMMER AT CENSUS* scholars. See the listing under Section 5.

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

Erdman, C. (In Press). "Development of Interviewer Response Rate Standards for National Surveys", *Field Methods.*

Joyce, P., Malec, D., Little, R. J. A., Gilary, A., Navarro, A., and Asiala, M. E. (2014). "Statistical Modeling Methodology for the Voting Rights Act Section 203 Language Assistance Determinations," *Journal of the American Statistical Association, 109*: 36-47.

Klein, M., Mathew, T., and Sinha, B. (2014). "Likelihood Based Inference Under Noise Multiplication," *Thailand Statistician: Journal of the Thai Statistical Association, 12*: 1-23.

Klein, M., Mathew, T., and Sinha, B. (2014). "Noise Multiplication for Statistical Disclosure Control of Extreme Values in Log-normal Regression Samples." *Journal of Privacy and Confidentiality, 6*: 77-125.

Klein, M. and Sinha, B. (In Press). "Likelihood-Based Finite Sample Inference for Synthetic Data Based on Exponential Model." *Thailand Statistician: Journal of The Thai Statistical Association.*

McElroy, T. and Holan, S. (2014). "Asymptotic Theory of Cepstral Random Fields." *Annals of Statistics, 42*: 64-86.

McElroy, T. and Maravall, A. (2014). "Optimal Signal Extraction with Correlated Components," *Journal of Time Series Econometrics, 6(2):* 237-273.

McElroy, T. and McCracken, M. (In Press). "Multi-Step Ahead Forecasting of Vector Time Series." *Econometrics Reviews.*

McElroy, T. and Monsell, B. (2014). "The Multiple Testing Problem for Box-Pierce Statistics," *Electronic Journal of Statistics, 8*: 497-522.

McElroy, T. and Monsell, B. (In Press). "Model Estimation, Prediction, and Signal Extraction for Nonstationary Stock and Flow Time Series Observed at Mixed Frequencies." *Journal of the American Statistical Association.*

McElroy, T. and Politis, D. (2014). "Spectral Density and Spectral Distribution Inference for Long Memory Time Series via Fixed-b Asymptotics." *Journal of Econometrics 182*, 211-225.

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

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McElroy, T. and Trimbur, T. (In Press). "Signal Extraction for Nonstationary Multivariate Time Series with Illustrations for Trend Inflation." *Journal of Time Series Analysis.*

Mulry, M. H., Oliver, B. E., and Kaputa, S. J. (2014). "Detecting and Treating Verified Influential Values in a Monthly Retail Trade Survey." *Journal of Official Statistics. 30(4)*: 721-747.

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Shao, J., Slud, E., Cheng, Y., Wang, S., and Hogue, C. (2014). "Theoretical and Empirical Properties of Model Assisted Decision-based Regression Estimators." *Survey Methodology, 40(1)*: 81-104.

Slud, E. and Suntornchost, J. (2014). "Parametric Survival Densities from Phase-type Models." *Lifetime Data Analysis 20*: 459-480.

Tang, M., Slud, E., and Pfeiffer, R. (2014). "Goodness of fit tests for linear mixed models." *Journal of Multivariate Analysis, 130:* 176-193.

Winkler, W. E. (In Press). "Matching and Record Linkage," *WIREs Computational Statistics*, doi: 10.1002/wics.1317.

Wright, T. (2014). "Lagrange's Identity and Congressional Apportionment," *The American Mathematical Monthly, 121*: 523-528.

Young, D. (2014). "Mixtures of Regressions with Changepoints," *Statistics and Computing, 24(2),* 265-281.

Young, D. (2014). "A Procedure for Approximate Negative Binomial Tolerance Intervals," *Journal of Statistical Computation and Simulation, 84(2):* 438-450.

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3.2 BOOKS/BOOK CHAPTERS

Lund, R. and Livsey, J. (In Press). "Renewal Based Count Time Series," in Davis, R., Holan, S., Lund, R., and Ravishanker, N. (Eds.), *Handbook of Discrete-valued Time Series.* New York: Chapman & Hall/CRC Press.

Lund, R., Holan, S., and Livsey, J. (In Press). "Long Memory Discrete-valued Time Series," in Livsey, J., Davis, R., Holan, S., Lund, R., and Ravishanker, N. (Eds.), *Handbook of Discrete-valued Time Series.* New York: Chapman & Hall/CRC Press.

McElroy, T. and Pang, O. (In Press). "The Algebraic Structure of Transformed Time Series," in Beran, Jan, Feng, Yuanhua, Hebbel, Hartmut (Eds.), *Empirical Economic and Financial Research: Theory, Methods, and Practice*. Springer.

McElroy, T. and Findley, D. (2014). "Fitting Constrained Vector Autoregression Models," in J. Beran, Y. Feng, and H. Hebbel (Eds.), *Empirical Economic and Financial Research: Theory, Methods, and Practice*. New York: Springer.

Winkler, W. E. (In Press). "Probabilistic Linkage," in Goldstein, H., Harron, K., and Dibbel, C. (Eds.), *Methodological Developments in Linkage*. Wiley.

3.3 PROCEEDINGS PAPERS

Proceedings of the Federal Committee on Statistical Methodology Research Conference, Washington, D.C., November 4-6, 2013

- William Winkler, "Cleanup and Analysis of Sets of National Files," http://fcsm.sites.usa.gov/files/2014/05/J1_Winkler_2013FCSM.pdf

Joint Statistical Meetings, American Statistical Association , Montreal, Québec, Canada, August 3 – 8, 2013.
2013 Proceedings of the American Statistical Association

- Taniecea Arceneaux and Burton Singer, "Link Prediction and Missing Data in Social Network Surveys: An Initial Exploration," 3100-3113.
- Jerzy Wieczorek and Carolina Franco, "An Empirical Artificial Population and Sampling Design for Small- Area Model Enumeration," 1087-1097.

- Carolina Franco and William Bell, "Applying Bivariate Binomial/Logit Normal Models to Small-Area Estimation," 690-702.
- Maria Garcia, Adreana Able, and Christopher Grieves, "Evaluation of Selective Editing for the Census Bureau Foreign Trade Data," 1116-1129.
- Aaron Gilary, Jerry Maples, and Eric Slud, "Validity Testing for Coverage Properties of Small-Area Models for Cell Proportions," 1865-1875.
- Jerry Maples and Matthew Brault, "Improving Small-Area Estimates of Disability: Combining the American Community Survey with the Survey of Income and Program Participation," 1076-1086.
- Kevin Tolliver and Tucker McElroy, "Comparing Maximum Likelihood Estimation on Time Series Data," 2053-2065.
- Mary Mulry, Broderick Oliver, Stephen Kaputa, and Katherine Thompson, "Setting M-Estimation Parameters for Detection and Treatment of Influential Values," 1424-1438.
- Andrew Raim and Nagaraj K. Neerchal. ""Modeling Overdispersion in Binomial Data with Regression Linked to a Finite Mixture Probability of Success," 2760-2774.
- Eric Slud, Christopher Grieves, and Reid Rottach, "Single-Stage Generalized Raking Weight Adjustment in the Current Population Survey," 195-207.

3.4 CENTER FOR STATISTICAL RESEARCH & METHODOLOGY RESEARCH REPORTS

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

RR (Statistics #2013-07): Joseph Schafer. "Effects of interviewer refresher training and performance monitoring in the 2011 National Crime Victimization Survey," October 23, 2014.

RR (Statistics #2014-01): Eric V. Slud. "Moderate-Sample Behavior of Adaptively Pooled Stratified Regression Estimators," June 19, 2014.

RR (Statistics #2014-02): Joseph Schafer. "Modeling the Effects of Recent Field Interventions in the National Crime Victimization Survey," April 3, 2014.

RR (Statistics #2014-03): Osbert Pang and Tucker McElroy. "Forecasting Fertility and Mortality by Race/Ethnicity and Gender," July 15, 2014.

RR (Statistics #2014-04): Pat Hunley. "Proof of Equivalence of Webster's Method and Willcox's Method of Major Fractions," July 17, 2014.

RR (Statistics #2014-05): Ryan Janicki and Donald Malec. "A Small Sample Evaluation of Design-Adjusted Likelihoods Using Bernoulli Outcomes," July 22, 2014.

RR (Statistics #2014-06): Ben Klemens. "A Useful Algebraic System of Statistical Models," July 24, 2014.

RR (Statistics #2014-07): Tommy Wright. "A Simple Method of Exact Optimal Sample Allocation under Stratification with Any Mixed Constraint Patterns," August 24, 2014.

RR (Statistics #2014-08): Chandra Erdman and Nancy Bates. "The U.S. Census Bureau Mail Return Rate Challenge: Crowdsourcing to Develop a Hard-to-Count Score," August 12, 2014.

RR (Statistics #2014-09): James Livesy, Osbert Pang, and Tucker McElroy. "Effect of Trading Day Regressors on Seasonal Adjustment of Growth Rates," September 5, 2014.

4. TALKS AND PRESENTATIONS

2013 Pi Mu Epsilon Address, Mathematics Department, Villanova University, Villanova, PA, April 26, 2013.

- Wright, Tommy, "Equal Proportions for Congressional Apportionment."

Department of Mathematics and Statistics Colloquium, University of Maryland, Baltimore County, MD, September 6, 2013.

- Wright, Tommy, "The Equivalence of Neyman Optimum Allocation for Sampling and Equal Proportions for Apportioning the U.S. House of Representatives."

2013 Time Series Conference, Federal Reserve Board, Washington D.C., September 27, 2013.

- Findley, David (with Demetra Lytras), "Detecting Seasonality in Unadjusted and Seasonally Adjusted Time Series."

Federal Committee on Statistical Methodology Research Conference, Washington, D.C., November 4-6, 2013

- Erdman, Chandra, "The U.S. Census Bureau Mail Return Rate Challenge: Crowdsourcing to Develop a Hard-to-Count Score."
- Winkler, William, "Discussion of two papers on modeling/edit/imputation and one on editing/confidentiality."
- Winkler, William, "Clean-up and Analysis of Sets of National Files."

Department of Mathematics and Statistics Colloquium, American University, Washington, D.C., November 19, 2013.

- Wright, Tommy, "The Equivalence of Neyman Optimum Allocation for Sampling and Equal Proportions for Apportioning the U.S. House of Representatives."

Department of Mathematics and Statistics, University of Maryland, Baltimore County; Baltimore, MD, December, 6, 2013.

- Klein, Martin. "Likelihood-Based Finite Sample Inference for Synthetic Data."

Computational Methods for Censuses and Surveys, Statistical and Applied Mathematical Sciences Institute, Washington, D.C., January 8-10, 2014.

- Winkler, William, "Quality and Analysis of Sets of National Files."

Department of Mathematics Colloquium, Howard University, Washington, D.C., January 24, 2014.

- Wright, Tommy, "Equal Proportions for Congressional Apportionment."

Department of Mathematics and Statistics Colloquium, Georgetown University, Washington, D.C., February 7, 2014.

- Wright, Tommy, "The Equivalence of Neyman Optimum Allocation for Sampling and Equal Proportions for Apportioning the U.S. House of Representatives."

Department of Statistics Colloquium, Michigan State University, East Lansing, MI, February 25, 2014.

- Slud, Eric, "Modeling Frame Deficiencies for Improved Calibration."

Department of Statistics Colloquium, University of Maryland Baltimore County, Baltimore, MD, February 28, 2014.

- Livsey, James, "Renewal Based Count Time Series."

Ordered Data Analysis, Models and Health Research Methods, University of Texas at Dallas, Dallas, TX, March 7-9, 2014.

- McElroy, Tucker, "Tail Index Estimation with a Fixed Tuning Parameter Fraction."

Department of Biostatistics Colloquium, Columbia University, New York, NY, March 11, 2014.

- Slud, Eric, "Modeling Frame Deficiencies for Improved Calibration."

Celebrating 25 years of TRAMO SEATS and the 70th birthday of Agustín Maravall, Bank of Spain, Madrid, Spain, March 13-14.

- Monsell, Brian, "Moving Holidays – Motivations and Case Study."

U.S. Bureau of Labor Statistics Statistical Seminar, Washington, D.C., April 14, 2014.

- Franco, Carolina, "Applying Bivariate Binomial/Logit Normal Models to Small Area Estimation." Joint work with William R. Bell, (ADRM).

Department of Statistics Seminar, The George Washington University, Washington, D.C., April 18, 2014.

- Wright, Tommy, "The Equivalence of Neyman Optimal Allocation for Sampling and Equal Proportions for Apportioning the U.S. House of Representatives."

8th Annual Probability and Statistics Day at University of Maryland Baltimore County, Special Alumni Session, Baltimore, MD, April 19, 2014.

- Klein, Martin, "Likelihood-Based Finite Sample Inference for Synthetic Data Based on Normal and Linear Regression Models."

Department of Mathematics Colloquium, Lehigh University, Bethlehem, PA, April 23, 2014.

- Klein, Martin, "Statistical Analysis of Noise Multiplied Data Using Multiple Imputation."

Department of Mathematics and Statistics Colloquium, Georgia State University, Atlanta, GA, May 2, 2014.

- Klein, Martin, "Likelihood-Based Finite Sample Inference for Synthetic Data Based on Normal and Linear Regression Models."

Central Bank of the Dominican Republic, Santo Domingo, Dominican Republic, May 19-23, 2014.

- Monsell, Brian (with Demetra Lytras), "Seasonal Adjustment with X-13ARIMA-SEATS."

Society of Prevention Research Annual Meeting, Washington, D.C., May 27-30, 2014.

- Gilary, Aaron and Liu, Benmei, "Small Area Estimation in the Tobacco Use Supplement to the Current Population Survey."

Conference on Frontiers of Hierarchical Modeling in Observational Studies, Complex Surveys, and Big Data Honoring Malay Ghosh, College Park, MD, May 29-31, 2014.

- Liu, Benmei and Gilary, Aaron, "Small Area Estimation in the Tobacco Use Supplement to the Current Population Survey."
- Slud, Eric, "Survey Estimating Equations under Nonstandard MAR Models."

2014 ICSA/KISS Applied Statistics Symposium, Portland, OR, June 15-18, 2014.

- Monsell, Brian, "Time Series Research at the Census Bureau."

Southern Taiwan Statistical Association Annual Meeting, Hualien, Taiwan, June 24, 2014.

- Findley, David, (with Demetra Lytras), "Detecting Seasonality in Unadjusted and Seasonally Adjusted Time Series."

Statistics Korea, Deajeon, South Korea, July 2, 2014.

- Findley, David, "A Fundamental Time Series Model for Model-Based Seasonal Adjustment."

2014 International Indian Statistical Association Conference, UC Riverside, July 11-13, 2014.

- McElroy, Tucker, "Multivariate Seasonal Adjustment, Economic Identities, and Seasonal Taxonomy."

DC-AAPOR & WSS Summer Conference Preview/Review 201,. Washington, DC, July 30-31, 2014.

- Mulry, Mary, Nichols, Elizabeth, and Childs, Jennifer, "Study of Error in Survey Reports of Move Month Using the U.S. Postal Service Change of Address Records."

Joint Statistical Meetings , American Statistical Association, Boston, MA, August 2-7, 2014.

- Yang Cheng, Adrijo Chakraborty, and Gauri Datta, "A Hierarchical Bayesian Method for Combining Surveys."
- Stephanie Coffey, Chandra Erdman, and Benjamin Reist, "Predicting Initial Response Mode in Advance of Data Collection in the NSCG."
- Chandra Erdman and Stephanie Coffey, "Predicting Response Mode During Data Collection in the National Survey of College Graduates."
- David Findley and Demetra Lytras, "A Study of Diagnostics for Detecting Seasonality and Residual Seasonality."
- David Findley, "A Spectral and Other Diagnostics for Seasonality."
- Carolina Franco, Roderick Little, Thomas Louis, and Eric Slud, "Coverage Properties of Confidence Intervals for Proportions in Complex Surveys."
- Yi Huang, Elando Baro, and Anindya Roy, "Bayesian Latent Propensity Score Approach for Average Causel Effect Estimation Allowing Covariate Measurement Error."
- Ryan Janicki and Tucker McElroy, "Hermite Expansion and Estimation of Monotonic Transformations of Gaussian Data."
- Patrick Joyce, "Evaluations of Hierarchical Distribution for Small Area Models."
- Joanna Lineback, Martin Klein, and Joseph Schafer, "Investigating Nonresponse Error in Change Estimates."
- Peter Linton, Anindya Roy, and Tucker McElroy, "A Stationary Parameterization of VAR and VARMA Models."
- Benmei Liu and Aaron Giliary, "Small Area Estimation for the Tobacco-Use Supplement to the Current Population Survey."
- James Livsey, "Time Series Model Comparison Residual Diagnostics."
- Tucker McElroy, "Fast Estimation of Time Series with Multiple Spectral Peaks."
- Brain Monsell, "The Effect of Forecasting on X-11 Adjustment Filters."
- Darcy Morris, "A Comparison of Methodologies for Classification of Administrative Records Quality for Census Enumeration."
- Mary Mulry, Elizabeth Nichols, and Jennifer Childs, "Study of Error in Survey Reports of Move Month Using the U.S. Postal Service Change of Address Records."
- Andrew Raim and Nagaraj Neerchal, "Large Cluster Approximation to the Information Matrix Using Complete Data."
- Anindya Roy and Tucker McElroy, "Testing for Visual Significance in Seasonally Adjusted Time Series."
- Kimberly Sellers, "Modeling Counts via the Conway-Maxwell-Poisson Distribution: 'For the Health of It'."
- Brian Shaffer, Yang Cheng, and Eric Slud, "Single-Stage Generalized Raking Application in the American Housing Survey."
- Eric Slud, "Modeling Frame Deficiencies and the Effect of Calibration."
- Yves Thibaudeau and Eric Slud, "Log-Linear Models for Prediction in Surveys."
- William Winkler, "Quality and Analysis of Sets of National Files."
- William Winkler, "Valid Analytic Properties and Disclosure Limitation for Microdata."
- Tommy Wright, "A Simple Method of Exact Optimal Sample Allocation Under Stratification with Any Mixed Constraint Patterns."
- Jiashen You, Gauri Datta, and Jerry Maples, "Modeling Disability Data in Small Areas."
- Derek Young and Andrew Raim, "Zero-Inflated Regression Modeling for Coverage Errors of the Master Address File."
- Martin Klein, "Likelihood-Based Finite Sample Inference for Synthetic Data Based on Normal and Linear Regression Models."
- Martin Klein, J. Lineback, and Joseph Schafer, "Investigating Nonresponse Error in Change Estimates."

Data Science DC, George Washington University, August 28, 2014.

- Klemens, Ben, "Transforming and Combining Statistical Models."

Small Area Estimation Meeting 2014, Invited Session—Small Area Estimation for Repeated Surveys, Poznan, Poland, September 3, 2014.

- Bell, William R. and Franco, Carolina, "Alternative Approaches to Borrowing Information over Time in Small Area Estimation with Application to Data from the Census Bureau's American Community Survey."

LeHigh University, Bethlehem, PA, September 3, 2014.

- McElroy, Tucker, "Optimal Real-Time Filters for Linear Prediction Problems."

25th International Workshop on Household Survey Nonresponse, Reykjavik, Iceland, September 4, 2014.

- Erdman, Chandra, "Developing a Dynamic Model for Mode Switching in the 2015 National Survey of College Graduates."

6th International Workshop on Internet Survey and Survey Methodology, Daejeon, Republic of Korea, September 17, 2014.

- Wright, Tommy, "A Simple and General Method of Exact Optimal Sample Allocation."

Reserve Bank of India, Mumbai, India, September 25, 2014.

- McElroy, Tucker, "Multivariate Seasonal Adjustment, Economic Identities, and Seasonal Taxonomy."

5. CENTER FOR STATISTICAL RESEARCH AND METHODOLOGY SEMINAR SERIES

Andrew Raim, University of Maryland, Baltimore County, "Mixture Link Models for Binomial Data with Overdispersion," November 21, 2013.

Richard Kuhn, National Institute of Standards & Technology, "Combinatorial Testing for Software, Methods, Tools, and Application," March 13, 2014.

Robert Lund, Clemson University, "Periodic Time Series," March 20, 2014.

Scott Holan, University of Missouri, "A Bayesian Approach to Estimating Agricultural Yield Based on Multiple Repeated Surveys," March 31, 2014.

Hang J. Kim, Duke University & National Institute of Statistical Science (NISS), "Bayesian Data Editing for Continuous Microdata," April 9, 2014.

Avinash C. Singh, National Opinion Research Center at the University of Chicago, *SUMMER AT CENSUS*, "A Bayesian-Frequentist Integrated Approach to Small Area Estimation," April 9, 2014.

Avinash C. Singh, National Opinion Research Center at the University of Chicago, *SUMMER AT CENSUS*, "Aggregate Level PUF with High Data Confidentiality and Utility," April 10, 2014.

Adrian E. Raftery, University of Washington, "Bayesian Reconstruction of Past Populations for Developing and Developed Countries," April 24, 2014.

Jian-Guo Liu, Duke University, *SUMMER AT CENSUS*, "Wealth Distribution in a Heterogeneous Environment," May 13, 2014.

Brunero Liseo, University of Rome, La Sapienza, *SUMMER AT CENSUS*, "Hierarchical Bayesian Record Linkage and Inference with Linked Data: Problems and Some Solutions," May 28, 2014.

Julie A. Dowling, University of Illinois at Urbana-Champaign, *SUMMER AT CENSUS*, "Mexican Americans and the Question of Race," June 4, 2014.

Kristin Smith, University of New Hampshire, *SUMMER AT CENSUS*, "Using SIPP to Understand Changes in Child Care During Times of Family and Economic Instability," June 10, 2014.

Barry Schouten, Statistics Netherlands and Utrecht University, *SUMMER AT CENSUS*, "Adaptive Mixed-mode Survey Designs," June 12, 2014.

Donald Rubin, Harvard University, *SUMMER AT CENSUS*, "Essential Concepts for Causal Inference in Randomized Experiments and Observational Studies," June 16, 2014.

Donald Rubin, Harvard University, *SUMMER AT CENSUS*, "On the Calibrated Bayesian in Design and Analysis," June 17, 2014.

John W. Emerson, Yale University, *SUMMER AT CENSUS*, "Scalable Strategies for Computing with Massive Data," June 19, 2014.

Jennifer Van Hook, Pennsylvania State University, *SUMMER AT CENSUS*, "Can We Spin Straw into Gold? An Evaluation of Legal Status Imputation Approaches," June 24, 2014.

Charles Manski, Northwestern University, *SUMMER AT CENSUS*, "Communicating Uncertainty in Official Economic Statistics," June 25, 2014.

Lucas Tcheuko, University of Maryland, College Park, "U-statistic Variance Based on a Two-way Random Effects Model," July 16, 2014.

Monica Boyd, University of Toronto, *SUMMER AT CENSUS*, "Making Sense of Canada's Voluntary Census: What Happened and What It Means," July 16, 2014.

Mick P. Couper, University of Michigan, *SUMMER AT CENSUS*, "Big Data: A Survey Researcher's Perspective," July 17, 2014.

Trivellore Raghunathan, University of Michigan, *SUMMER AT CENSUS*, "Combining Information from Multiple Sources for Medical Expenditure Modeling," July 17, 2014.

Jianhua Huang, Texas A&M University, *SUMMER AT CENSUS*, "Some Examples of Regularized Matrix Decomposition," July 23, 2014.

Bikas Sinha, Indiana University-Purdue University Indianapolis (Visiting Professor), Indian Statistical Institute (Retired Professor), *SUMMER AT CENSUS*, "Apportionment Index: Measure of Agreement in Forestry Research," July 24, 2014.

Carolyn Liebler, University of Minnesota, *SUMMER AT CENSUS*, "Race and Hispanic Origin Response Dynamics between Census 2000 and the 2010 Census," July 29, 2014.

Philip L.H. Yu, The University of Hong Kong, *SUMMER AT CENSUS*, "Analyzing and Modeling of Ranking Data," July 29, 2014.

Jesse Rothstein, University of California, Berkeley, *SUMMER AT CENSUS*, "Scraping By: Income and Program Participation after the Loss of Extended Unemployment Benefits," August 4, 2014.

Sookhee Oh, University of Missouri-Kansas City, *SUMMER AT CENSUS*, "Generation and Socioeconomic Attainment among Hispanic and Asian Immigrant Groups: The Comparison of CPS and ACS," August 5, 2014.

Perry Singleton, Syracuse University, *SUMMER AT CENSUS*, "Health Information and the Timing of Social Security Entitlements," August 11, 2014.

James Wagner, University of Michigan, *SUMMER AT CENSUS*, "Examining the Impact of Nonresponse on Estimates from the 2006-2010 Continuous NSFG," August 12, 2014.

James Foster, The George Washington University, *SUMMER AT CENSUS*, "Counting and Multidimensional Poverty Measurement," August 12, 2014.

Partha Lahiri, University of Maryland, College Park, *SUMMER AT CENSUS*, "The Role of Adjusted Residual Maximum Likelihood Estimation in Small Area Estimation," August 18, 2014.

John A. Harrington, Jr., Kansas State University, *SUMMER AT CENSUS*, "Spaces between Places: Understanding the Changing Character of the High Plains of Western Kansas," August 18, 2014.

Peter Lundquist, Statistics Sweden, *SUMMER AT CENSUS*, "Balanced Response Set: Some Theoretical Findings and Applications," August 19, 2014.

Jiming Jiang, University of California, Davis, *SUMMER AT CENSUS*, "Several Extensions of the Observed Best Prediction," August 25, 2014.

Joseph Ferrie, Northwestern University, *SUMMER AT CENSUS*, "Linked Census Data for the Analysis of Later-Life Effects of Early-Life Exposure to Environmental Hazards: The Case of Lead," August 26, 2014.

Natasha Pilkauskas, Columbia University, *SUMMER AT CENSUS*, "The Value of Support: Private Safety Nets among Families with Young Children," August 27, 2014.

Paul Biemer, RTI International, "A System for Managing the Quality of Official Statistics," September 4, 2014.

Ger Snijkers, Statistics Netherlands, *SUMMER AT CENSUS*, "A Systematic Methodology Aimed at Increasing Response for Business Surveys," September 9, 2014.

Soutir Bandyopadhyay, Lehigh University, "A Test for Stationarity for Irregular Spaced Spatial Data," September 10, 2014.

Robert Ashmead, The Ohio State University, "Estimating Causal Effects using Propensity Score Estimators with Complex Survey Data," September 11, 2014.

Zhen-Qing Chen, University of Washington, *SUMMER AT CENSUS*, "Scaling Limits of Interacting Diffusions in Domains," September 16, 2014.

Agustin Maravall, Bank of Spain, *SUMMER AT CENSUS*, "Automatic Model-Based Seasonal Adjustment at Work," September 23, 2014.

6. PERSONNEL ITEMS

6.1 HONORS/AWARDS/SPECIAL RECOGNITION

6.2 SIGNIFICANT SERVICE TO PROFESSION

Chandra Erdman
- Refereed a paper for *Computational Statistics*

David Findley
- Invited discussant of Prof. Jonathan Wright's talk and related criticisms of official seasonal adjustments at the start of the Great Recession at Bureau of Labor Statistics (BLS), October 30, 2013

Carolina Franco
- Refereed a paper for *The American Statistician*

Maria Garcia
- Reviewer, *UN/ECE Glossary of Terms on Statistical Data Editing*
- Session Organizer and Discussant, "New and Emerging Methods in Editing and Imputation", 2014 UN/ECE Work Session on Statistical Data Editing

Ryan Janicki
- Reviewer, National Science Foundation Proposal

Martin Klein
- Refereed papers for *Journal of Official Statistics* and *Sankhya B: The Indian Journal of Statistics*
- Member, Ph.D. Dissertation in Statistics Committee, University of Maryland, Baltimore County

James Livsey
- Refereed papers for *Applied Stochastic Models in Business and Industry*
- Judge, University of Maryland Baltimore County Probability and Statistics Day
- Reviewer, ASA/NSF/Census Research Fellowship Application

Jerry Maples
- Refereed papers for *Journal of Survey Statistics and Methodology* and *International Statistics Review*

Thomas Mathew
- Associate Editor, *Journal of the American Statistical Association*
- Associate Editor, *Statistical Methodology*
- Associate Editor, *Sankhya, Series B*
- Member, American Statistical Association's Committee on W. J. Youden Award in Inter-laboratory Testing
- Refereed papers for *Journal of Biopharmaceutical Statistics, Scandinavian Journal of Statistics, Statistics and Probability Letters, Statistics in Medicine*

Tucker McElroy
- Refereed papers for *Annals of Statistics, Computational Statistics and Data Analysis, Econometric Review, Journal of Statistical Planning and Inference,* and *Review of Economics and Statistics*
- Reviewer, National Science Foundation Panel
- Organized and chaired a topic-contributed session at the Joint Statistical Meetings

Mary Mulry
- Vice President, American Statistical Association (2011 – 2013)
- Associate Editor, *Journal of Official Statistics*

- Member, Program Committee, 2014 International Total Survey Error Workshop, Washington, D.C., October 1-3, 2014

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

Andrew Raim
- Refereed papers for *Journal of Statistical Computation and Simulation* and *Statistical Methodology*

Joseph Schafer
- Member, FCSM Interagency Working Group on Adoptive Design
- Advisor, Ph.D. Candidate, University of Maryland, College Park

Eric Slud
- Associate Editor, *Lifetime Data Analysis*
- Associate Editor, *Journal of Survey Statistics and Methodology*
- Associate Editor, *Biometrika*
- Refereed papers for *Statistical Theory and Practice*, *Statistics in Biopharmaceutical Research, Journal of Official Statistics, Canadian Journal of Statistics, Haematology, and Annals of Statistics*
- Member, Hansen Lecture Committee, Washington Statistical Society

William Winkler
- Refereed papers for *International Statistical Review*, *Annals of Applied Statistics* and *Journal of Survey Statistics and Methodology*
- Associate Editor, *Journal of Privacy and Confidentiality*
- Associate Editor, *Transactions on Data Privacy*
- Member, Program Committee for *Statistical Data Protection 2014*
- Member, Program Committee for *IEEE ICDM DINA'14: Workshop on Data Integration and Applications*
- Member, Statistics Ph.D. Committee, Carnegie-Mellon University

Tommy Wright
- Associate Editor, *The American Statistician*
- Member, AAAS Review Panel for 2014 Science and Technology "Big Data" Fellows
- Member, Waksberg Award Committee, *Survey Methodology*
- Member, Board of Trustees, National Institute of Statistical Sciences
- Organizer, Invited Paper Session—"Rankings by Statistical Agencies Based on Sample Survey Data," 60th World Statistics Congress/International Statistical Institute (ISI), Brazil (2015).
- Member, 2015 Jan Tinberger Award Committee, International Statistical Institute

Derek Young
- Refereed papers for the *Journal of Applied Statistics*, *Communications in Statistics – Simulation and Computation* (2), *Biometrics*, *Communications in Statistics – Theory and Methods*, *Annals of Applied Statistics*, and *Statistica Sinica*

6.3 PERSONNEL NOTES

Kevin Shaw joined our center on detail from the Demographic Statistical Studies Division.

Sarah Wilson moved to Florida.

Andrew Raim joined our Experimentation, Simulation, & Modeling Research Group.

Derek Young accepted a faculty position in statistics at the University of Kentucky.

Nathan Yau (Flowingdata.com) accepted a Schedule A appointment in our Statistical Computing Applications & Data Visualization Research Group.

Kimberly Sellers (Faculty at Georgetown University) joined our Center as an ASA/NSF/Census Research Fellow.

Josh Tokle accepted a position with the American Institutes for Research.

Lauren Emanuel (senior English major at the University of Maryland, College Park) joined our center as an editorial intern.

APPENDIX A **Center for Statistical Research and Methodology FY 2014**
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		
6410402 / 6810407	Redesign/Improvement Person Follow-Up		
	1. Decennial Record Linkage	William Winkler	Tom Mule
	2. Coverage Measurement Research	Jerry Maples	Pat Cantwell
	3. Using 2010 Census Coverage Measurement Data to Compare Nonresponse Followup Proxy Responses with Administrative Records	Mary Mulry	Tom Mule
	4. Record Linkage Error-Rate Estimation Methods	William Winkler	Tom Mule
	5. Supplementing and Supporting Non-Response with Administrative Records	Michael Ikeda	Tom Mule
	6. Identifying "Good" Administrative Records for 2020 Census NRFU Curtailment Targeting	Darcy Steeg Morris	Tom Mule
6310401	MAF Error Project		
	7. Master Address File (MAF) Error Model and Quality Assessment	Derek Young/Andrew Raim	Deborah Fenstermaker
6510401	Coding, Editing, and Imputation Study		
	8. Software Development (Tea)	Ben Klemens	Tom Mule
	9. Software Analysis and Evaluation	Rolando Rodriguez	Andrew Keller
6810405	Matching Process Improvement		
	10. 2020 Unduplication Research	Michael Ikeda	Andreana Able
6385460	American Community Survey (ACS)		
	11. ACS Applications for Time Series Methods	Tucker McElroy	Mark Asiala
	12. ACS Imputation Research and Development	Yves Thibaudeau	Anthony Tersine
	13. Data Analysis of ACS CATI-CAPI Contact History	Eric Slud	Todd Hughes
	14. Confidence Intervals for Proportions in ACS Data	Carolina Franco	Mark Asiala
	15. Mode-Based Imputation in ACS	Eric Slud	Mark Asiala
	16. Voting Rights Section 203 Model Evaluation and Enhancements Towards Mid-Decadal Determinations	Patrick Joyce	Mark Asiala
	DEMOGRAPHIC		
TBA	Demographic Statistical Methods Division Special Projects		
	17. Special Project on Weighting and Estimation	Eric Slud	Yang Cheng
7491010	National Survey of College Graduates		
	18. National Survey of College Graduates	Chandra Erdman	Benjamin M. Reist
0906/1442	Demographic Surveys Division Special Projects		
	19. Data Integration	Ned Porter	Christopher Boniface
7523013	National Crime Victimization Survey		
	20. Analyzing the Effects of Sample Reinstatement and Process Monitoring and Fitness for Use	Joe Schafer	Meagan M. Meuchel
7165014	Social, Economic, and Housing Statistics Division Small Area Estimation Projects		
	21. Research for Small Area Income and Poverty Estimates (SAIPE)	Jerry Maples	Wes Basel
	22. Small Area Health Insurance Estimates (SAHIE)	Ryan Janicki	Wes Basel
0189115	Improving Poverty Measures/IOE		
	23. Tract Level Estimates of Poverty from Multi-year ACS Data	Jerry Maples	Wes Basel
	24. Small Area Estimates of Disability	Jerry Maples	Wes Basel
	ECONOMIC		
2320452	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. Supporting Documentation and Software: X-12-ARIMA and X-13A-S	Brian Monsell	Kathleen McDonald-Johnson
1183020 / 2320457	Economic Statistical Collection		
	29. Research on Imputation Methodology for the Monthly Wholesale Trade Survey	Martin Klein	Joanna Fane Lineback
	30. Use of Big Data for Retail Sales	Darcy Steeg Morris/Tommy Wright	Bill Davie
2320410 / 2320454	Economic Missing Data/Product Line Data		
	31. Missing Data Adjustment Methods for Product Data in the Economic Census	Darcy Steeg Morris	Jenny Thompson
7275001	**NATIONAL CANCER INSTITUTE**		
	32. Tobacco Use Supplement Small Domain Models	Aaron Gilary	Benmei Liu
TBA	**ADMINISTRATION AND CFO**		
	33. Assessment of Finance Methodology	Tommy Wright	Robin Guinn

APPENDIX B

FY 2014 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 eleventh year to provide *seven measures of performance*, this time for the fiscal year 2014. For FY 2014, the *measures of performance* for our center are:

- *Measure 1. Overall, Work Met Expectations:* Percent of FY 2014 Program Sponsored Projects/Subprojects where sponsors reported that work met their expectations.
- *Measure 2. Established Major Deadlines Met:* Percent of FY 2014 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 2014 Program Sponsored Projects/Subprojects reporting at least one improved method, developed technique, solution, or new insight.
- *Measure 3b. Plans for Implementation*: Of the FY 2014 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 2014 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 2014.
- *Measure 6. Proceedings Publications:* Number of proceedings publications documenting research that appeared in FY 2014.

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 January 14 thru January 23, 2015 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 2014 ***(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 2014 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 2014 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 2014 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 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
- William Yancey

Statistical Computing Applications & Data Visualization Research

Ben Klemens
- Tom Petkunas
- Ned Porter
- Rolando Rodriguez
- Nathan Yau (FLOWING DATA.COM)

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

Small Area Estimation Research

Jerry Maples
- Gauri Datta (U. of GA)
- Aaron Gilary
- Ryan Janicki
- Jiashen You

Time Series Research

Brian Monsell
- David Findley
- Osbert Pang

Tucker McElroy
- James Livsey
- Aninyda Roy (UMBC)

Experimentation, Simulation, & Modeling Research

Tommy Wright (Acting)
- Thomas Mathew (UMBC)
- Andrew Raim
- Derrick Simmons (S)

Tommy Wright, Chief
- Kelly Taylor
- Lauren Emanuel (S)
- Michael Leibert
- Michael Hawkins
- Kimberly Sellers (F)

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